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No. 45

THE NAVIGATION OF THE ATLANTIC OCEAN

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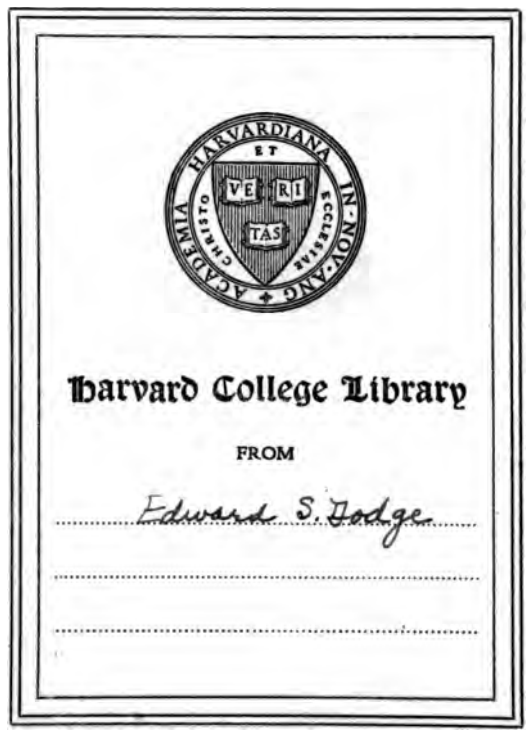

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No. 45.

THE NAVIGATION

OF

THE ATLANTIC OCEAN,

TRANSLATED FROM

THE FRENCH OF MONS. F. LABROSSE

BY

LIEUT. COMD'R J. B. COGHLAN, U. S. N.

SECOND EDITION.

WASHINGTON:
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1887.

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Edward S. Hodge

PREFACE.

The Navigation of the Atlantic Ocean, translated at this office, from the French of M. F. Labrosse, is a valuable addition to our knowledge of the winds, currents, and routes through this ocean. The edition of 1873 being exhausted, it is now republished for the benefit of mariners.

J. R. BARTLETT,
Hydrographer.

U. S. HYDROGRAPHIC OFFICE,
February, 1887.

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PART I.

GENERAL INSTRUCTIONS FOR THE NAVIGATION OF THE NORTH ATLANTIC OCEAN.

GENERAL INSTRUCTIONS

FOR THE

NAVIGATION OF THE NORTH ATLANTIC OCEAN.

CHAPTER I.

CALMS—WINDS—CURRENTS—ICEBERGS—BAROMETER.

Zones of calms. Equatorial and tropical calms.—The question of the calm-zones is important as well as complicated; important, because it is the subject which first attracts the attention of captains of sailing vessels, who constitute the larger part of navigators, without counting the captains of auxiliary steamers, whose desire is to consume the least possible amount of coal, or, in other words, money. We also say complicated, because we believe that the definition of calms is not always properly understood, and that very able men have held very different opinions on the subject.

We have always understood, and shall reason from this position, that a *calm* signifies a sea as smooth as oil, with or without a swell, but without the least perceptible breath of air, and in which vessels do not make the least appreciable headway, although they may have every stitch of sail set. So soon, then, as the log indicates a half knot of speed the calm has ended.

We will here remark that the pilot charts, on which may be found the percentage of calms likely to be met with in each square, are made from observations extending through periods of eight hours. Also, that a zone marked as having 16 per cent. of calms, signifies that in sixteen cases out of one hundred calms will be experienced. There remain eighty-four cases in which winds will be met with; but what are they? The charts point out the directions from which these eighty-four winds may blow, as also the proportion from each point of the compass, but they do not indicate their strength. Until other charts continue this useful information, the reasoning can only be carried on approximately. This we propose to do.

As a general rule, before a calm sets in there is observed a period of light, soft breezes, or "cat's-paws," which gradually become more feeble, until they finally die out; and, on the other hand, when a calm ends there is first a period of these same "cat's paws," which gradually gain in strength and persistency. We shall leave to each navigator the task of estimating the proportion of very light breezes likely to be encountered by referring to the number of calms. To us it does not seem an exaggeration to count upon a number of light, poorly-established "cat's-paws," equal to the number of observed calms. But we do not wish to force this view upon others; we consider it necessary, however, to state an opinion on the subject, and to take it into account. Thus, according to our idea, the zone which was mentioned before, for which the pilot-charts indicate a proportion of 16 per cent. of calms, should also contain 16 per cent. of "cat's-paws;" that is to say, in this zone sailing vessels would have thirty-two chances in a hundred against making a quick passage across it, while there would be sixty-eight chances in their favor.

Laying aside these considerations, we proceed to give four tables, one for each season of the year, containing the chances of encountering calms in the North Atlantic Ocean. The figures of these tables represent the percentage; that is to say, the number of calms observed in one hundred observations, as has been noted in various localities of the Atlantic.

The vertical argument is the latitude, while the horizontal is the longitude. In this way it becomes a sort of chart of calms.*

These tables may be useful when seeking for the chances of being delayed on a voyage in any part of the Atlantic; above all they will be of service by showing that the tropical calms do not form bands or zones of latitude, but that there are sometimes as many chances of encountering calms in the middle of the trade-wind zones, or in the regions of variable winds, as there are in the zones laid down for calms.

The region of equatorial calms, that is, the zone lying a little north of the equator, in which there is from 5 to 20 per cent. of calms to be encountered, has the double inconvenience of retarding a vessel and of keeping her in a region of humid or rainy weather, where the heavy, cloudy atmosphere is fatiguing, as well as enervating, to the crew. In this region from four to seven hours per day of rain may be looked for during the passage from the NE. to the SE. trade-winds, or when traversing the zones of calms and light airs.

* The longitudes, although reckoned from Paris in the original, have been reduced to the meridian of Greenwich by the translator.

Table showing the chances of calms.

[The figures indicate the number of times per hundred that calms have been encountered.]

North latitudes.	Longitudes. West. West of 90°.	85° to 90°.	80° to 85°.	75° to 80°.	70° to 75°.	65° to 70°.	60° to 65°.	55° to 60°.	50° to 55°.	45° to 50°.	40° to 45°.	35° to 40°.	30° to 35°.	25° to 30°.	20° to 25°.	15° to 20°.	10° to 15°.	5° to 10°.	0° to 5°.	East. 0° to 5°.	5° to 10°.
January, February, March:																					
From 50° to 55°	United States												0	4	0	9	4				
45° to 50°										3	1	4	5	4	5	3	2	7	9		
40° to 45°						4	4	7	6	3	6	4	4	4	2	0	0				
35° to 40°					4	4	6	3	5	2	3	3	7	11	6	2	3	0	0		
30° to 35°					3	4	9	4	4	2	5	0	4	4	7	3	0	0			
25° to 30°	0	4	7	5	5	5	8	11	4	5	7	7	5	5	5	3					
20° to 25°	7	4	5	12	3	4	5	5	4	7	2	7	3	3	5	4					
15° to 20°		0	11	11	5	0	3	4	4	5	5	4	3	5	3	0	Africa				
10° to 15°				0	0	0	4	4	0	2	3	3	3	2	2	5					
5° to 10°								0	0	0	0	2	2	2	51	8	21				
0° to 5°										8	6	6	9	16	21	5	10	5	0	7	5
April, May, June:																					
From 50° to 55°	United States												9	0	5	3	5	5			
45° to 50°									5	0	8	5	5	5	5	7	6	3			
40° to 45°						5	4	4	5	5	5	2	2	3	2	3	3				
35° to 40°					5	3	4	4	5	3	4	5	5	7	2	2	5	3	15		
30° to 35°					3	5	3	9	2	11	6	6	3	10	4	2	0				
25° to 30°	6	5	14	7	7	6	6	4	2	0	13	13	8	4	2	2					
20° to 25°	0	10	11	3	0	2	3	4	3	4	10	6	6	2	3	5	Africa				
15° to 20°		0	9	4	4	0	3	3	3	2	3	3	2	0	3	0					
10° to 15°			0			0	0	9	2	0	0	0	3	4	4	16					
5° to 10°								0	25	2	6	6	18	9	15	18	17				
0° to 5°										7	7	10	10	20	22	18	8	7	11	0	13
July, August, September:																					
From 50° to 55°	United States												8	0	13	5	8	6			
45° to 50°								0	0	7	6	5	7	4	6	5	2	2	4		
40° to 45°						7	7	6	5	6	5	5	5	9	3	7	4				
35° to 40°					6	7	4	4	5	4	3	3	5	8	3	4	4	9	21		
30° to 35°				0	4	4	7	12	0	5	9	7	5	7	6	2	3				
25° to 30°	15	8	11	6	6	8	9	11	16	6	12	8	9	3	3	0					
20° to 25°	6	4	7	6	6	5	4	4	7	5	5	5	2	2	0	0	Africa				
15° to 20°		8	0	14	6	0	0	0	0	2	2	2	2	3	5	0					
10° to 15°			0	14	0	3	0	4	5	2	11	7	8	13	11	3					
5° to 10°								0	15	9	21	21	15	8	8	6	0				
0° to 5°										0	4	2	4	2	3	2	2	0	3	2	3
October, November, December:																					
From 50° to 55°	United States												0	7	5	2	8	5	5		
45° to 50°									5	5	4	5	3	4	2	3	4	3	3		
40° to 45°						4	5	3	5	2	4	7	6	8	1	5	4				
35° to 40°					3	4	3	4	2	1	4	4	4	3	4	6	5	4	5		
30° to 35°					5	6	9	2	4	5	4	7	2	11	13	9	7				
25° to 30°	0	3	4	8	5	9	4	5	11	10	5	3	9	12	3	2					
20° to 25°	17	4	4	4	7	4	4	5	2	0	10	8	5	8	7	5	Africa				
15° to 20°		13	7	7	13	4	0	3	5	6	6	8	4	5	3	0					
10° to 15°				2	0	0	0	0	5	3	5	9	7	6	9	8					
5° to 10°								0	6	14	7	11	15	17	25	27	35				
0° to 5°										0	3	3	7	11	15	16	9	12	12	9	10

North Atlantic trade-winds. The directions of the North Atlantic trade-winds vary considerably according to the season of the year and the locality. The general direction is ENE., but they often haul to NE., or NNE., and at other times to E., occasionally even to ESE.

It is well known that it generally blows a fine, fresh breeze in the trades. By consulting the preceding tables of chances, more exact information may be obtained as to the force of the wind. The smaller the number of chances of calms in a square of five degrees, the more likelihood there will be of finding good breezes, and *vice versa.* This information is very useful, particularly when choosing the parallel of latitude to be taken for making a passage to the westward, when bound

to the West Indies, &c. Moreover, the advice we shall presently give will, as a general thing, settle any doubt regarding that subject.

The question of the *limit* of the trade-winds is about as delicate to handle as was that of the zones of calms, and for the same reazons, viz, the want of a proper definition of the term. Thus, if all winds between N. and E. are called trades, it can be seen that it will be extremely difficult to fix a limit, even approximately, for the trades of the North Atlantic Ocean to the eastward of the eighteenth degree of west longitude. In that eastern portion of the Atlantic from Cape Finisterre on the NW. coast of Spain to the vicinity of the Canary Islands, the prevailing winds are from NW. around to NE.; while about the latter locality they often change to NE., or ENE., without the intervention of calms. It can really be said, then, under certain circumstances, that the trades begin on the coast of Portugal; but this remark may lead to grave miscalculations on the part of navigators who place too implicit dependence on it.

We shall in the first place give a table of the northern limits of the NE. trades, taken from Maury's Sailing Directions, giving the changes in latitude of these limits, from one season to another on the same meridian, and from one meridian to another in the same season.

West longitudes.	Mean polar latitudes of NE. trades.			
	In winter.	In spring.	In summer.	In autumn.
°	°	°	°	°
70	28	28.7	29.3	29
65	26.3	28	29.3	28.3
60	24	24.3	27.3	28.3
55	22	22.7	24.7	25
50	21	23.7	28.3	23.7
45	23	24.7	31.3	28.7
40	27.7	29.7	30.7	29.3
35	26	27.3	30.7	25.7
30	24.3	28.7	29.7	26.7
25	25.3	24.7	31.3	26.3
20	24.3	28.3	28.7	27
15	29	31	32	31.3
10	29	31.3	34.7	32

Rear-Admiral Bourgois, whose name is so great an authority on all meteorological subjects, also spent some time in the endeavor to find and fix the northern limits of the North Atlantic trades. We will give two tables, published some years ago in the Revue Maritime, which give the results of that distinguished officer's work:

Designation of limits.	Latitude of the polar limit of NE. trades.							
	East of thirty-fifth meridian.				West of thirty-fifth meridian.			
	First quarter.	Second quarter.	Third quarter.	Fourth quarter.	First quarter.	Second quarter.	Third quarter.	Fourth quarter.
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
Maximum latitude limit...	40 26	42 51	49 25	45 18	37 33	41 00	43 09	38 02
Minimum latitude limit....	5 41	17 00	19 19	16 15	18 06	25 12	26 22	16 51
Mean of latitude limits	28 08	30 31	36 21	28 25	26 45	31 15	34 48	28 48
Number of observations...	42	38	41	36	41	32	26	34

This first table points out the important fact that too much confidence should not be placed upon the mean limits of the NE. trades, as given by the nautical directions, as there is sometimes a difference of 300 leagues between the mean of latitude limits and the *maximum* or *minimum* latitude of the trade-winds.

The second table which we shall give, also the work of Admiral Bourgois, shows, under the name of "*rotations, direct or inverse,*" the general way in which the winds veer when entering or leaving the region of the trades, as experienced by vessels bound to or from Europe. It is understood that the rotation will be either direct or inverse, according as the wind hauls with or against the motion of the hands of a watch. In this table will also be found the number of observed calms and light airs experienced at the same time by the same vessels:

Rotation of the winds and observations of calms.	Vessels leaving Europe.					Vessels bound to Europe.				
	First quarter.	Second quarter.	Third quarter.	Fourth quarter.	Total.	First quarter.	Second quarter.	Third quarter.	Fourth quarter.	Total.
Direct	27	26	35	20	108	26	24	18	25	93
Inverse	3	2	.....	7	12	7	1	1	1	10
Calms or light airs	10	5	4	5	24	10	12	9	12	43
Total	40	33	39	32	144	43	37	28	38	146

This table proves that vessels leaving Europe and entering the trade-wind region to the eastward of the thirty-fifth meridian will have one hundred and eight chances in one hundred and forty-four in favor of the wind hauling, steadily and without interruption, from W. or NW. around to N. or NE.

The inverse rotation only happened twelve times in one hundred and forty-four, while but twenty-four vessels in one hundred and forty-four experienced calms and light airs as forming a period of transition. As for vessels returning to Europe, they all leave that region somewhere to the westward of the thirtieth, and very generally to the westward of the thirty-fifth, meridian of longitude. In their case the table shows that there are ninety-three chances in one hundred and forty-six in favor of a direct rotation; that is, that NE. or ENE. winds will haul to SE., SW., and W. without interruption, and that only ten times in one hundred and forty-six was the inverse rotation experienced, while the chances of calms and light airs forming a period of transition are forty-three in one hundred and forty-six, or rather a large percentage.

To complete these observations on the trades, it remains for us to give, for each month of the year, the equatorial limits of the NE. and SE. trade-winds; which latter often, and particularly in summer, drive the NE. trades several degrees above the line. These limits, taken from the "pilot charts," are, it must be understood, the *means* of different

observations, and we give them with the same reserve as we did the "polar limit" of the NE. trades. There will be found in this table the latitude for each meridian and each month where the NE. or SE. trade commences:

Equatorial limit of the NE. and SE. trade-winds.

Names of month and designation of limit to be given for trades.	West longitudes.									
	40° 00′ W.	37° 30′ W.	35° 00′ W.	32° 30′ W.	30° 00′ W.	27° 50′ W.	25° 00′ W.	22° 30′ W.	20° 00′ W.	17° 00′ W.
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
January ... NE.	3 0 N.	2 20 N.	1 40 N.	1 40 N.	2 10 N.	3 00 N.	4 20 N.	5 30 N.	6 30 N.	7 50 N.
January ... SE.	1 0 N.	0 40 N.	0 40 N.	0 55 N.	1 00 N.	1 15 N.	2 00 N.	2 40 N.	3 00 N.	3 20 N.
February.. NE.	2 30 N.	1 40 N.	1 10 N.	0 50 N.	0 55 N.	1 35 N.	2 40 N.	4 20 N.	5 30 N.	6 20 N.
February.. SE.	1 20 N.	1 15 N.	0 50 N.	0 25 N.	0 15 N.	0 35 N.	1 25 N.	1 55 N.	2 15 N.	2 30 N.
March ..... NE.	1 30 N.	0 40 N.	0 05 S.	0 10 S.	0 30 N.	1 10 N.	2 25 N.	3 50 N.	5 00 N.	5 50 N.
March ..... SE.	0 45 S.	0 30 S.	0 25 S.	0 55 S.	0 45 S.	0 05 N.	0 30 N.	0 40 N.	0 40 N.	0 50 N.
April ..... NE.	1 20 N.	0 25 N.	0 00	0 25 N.	1 00 N.	2 20 N.	4 00 N.	5 25 N.	6 45 N.	
April ..... SE.	0 55 S.	1 25 S.	1 40 S.	1 45 S.	1 40 S.	1 00 S.	1 25 N.	2 00 N.	2 20 N.	
May ..... NE.	3 35 N.	3 25 N.	3 00 N.	3 00 N.	3 25 N.	4 15 N.	5 25 N.	6 40 N.	8 20 N.	
May ..... SE.	0 30 N.	0 05 S.	0 05 N.	0 55 N.	1 55 N.	2 25 N.	3 00 N.	3 30 N.	3 35 N.	
June..... NE.	6 00 N.	6 00 N.	6 05 N.	6 45 N.	7 45 N.	8 30 N.	9 10 N.	10 30 N.	12 20 N.	
June..... SE.	4 00 N.	3 35 N.	3 10 N.	3 25 N.	4 00 N.	4 15 N.	4 30 N.	4 55 N.	5 35 N.	
July ..... NE.	8 35 N.	8 45 N.	8 50 N.	9 35 N.	10 30 N.	11 10 N.	12 00 N.	13 00 N.	14 05 N.	
July ..... SE.	4 00 N.	4 00 N.	4 10 N.	3 50 N.	3 15 N.	3 00 N.	3 10 N.	3 20 N.	3 15 N.	
August ... NE.	11 25 N.	11 35 N.	12 00 N.	12 20 N.	12 25 N.	12 20 N.	12 10 N.	12 20 N.	13 10 N.	
August ... SE.	5 00 N.	5 00 N.	5 00 N.	4 35 N.	3 50 N.	3 15 N.	3 10 N.	2 45 N.	1 45 N.	
September. NE.	11 35 N.	12 00 N.	12 00 N.	11 45 N.	11 20 N.	11 00 N.	11 00 N.	11 20 N.	12 00 N.	
September. SE.	6 00 N.	5 10 N.	3 40 N.	2 40 N.	2 15 N.	1 40 N.	1 20 N.	0 40 N.	0 00	
October.... NE.	10 00 N.	9 50 N.	9 50 N.	9 55 N.	10 00 N.	10 00 N.	9 55 N.	10 30 N.	12 20 N.	.....
October.... SE.	5 10 N.	4 50 N.	4 35 N.	3 30 N.	3 10 N.	3 35 N.	5 00 N.	7 00 N.	7 30 N.	.....
November . NE.	6 10 N.	5 40 N.	5 55 N.	6 00 N.	5 55 N.	6 00 N.	6 30 N.	7 35 N.	9 20 N.	.....
November . SE.	4 30 N.	4 10 N.	4 00 N.	3 35 N.	3 30 N.	3 35 N.	3 35 N.	4 00 N.	4 00 N.	4 10 N.
December . NE.	2 20 N.	3 05 N.	3 25 N.	3 25 N.	4 15 N.	4 35 N.	5 50 N.	7 00 N.	7 50 N.	.....
December . SE.	1 30 N.	2 30 N.	2 55 N.	2 30 N.	2 15 N.	2 30 N.	3 00 N.	3 35 N.	3 50 N.	.....

Time of southwest monsoon on the west coast of Africa.

Zone of westerly winds.—When running to the northward in the North Atlantic Ocean, after leaving the region of the trade-winds, a a zone called "the region of variable winds" is entered, in which the direction and force of the wind change in a very irregular manner. The equatorial limit of this zone oscillates toward the north in summer and toward the south in winter, a movement analogous to that of the polar limit of the trade-wind zone.

In the first place, laying aside all theory on the subject, it can be seen that in the region of variable winds there are two principal currents of air, which seem to be constantly struggling, the one against the other. They are, on the one hand, the polar current, which blows from the NW. or NE., and on the other, the tropical current, which blows from opposite directions.

These two currents cross each other, and the result, generally, is a westerly wind or current. According as the one or the other is the

stronger, the resultant will incline to a polar or a tropical breeze. Finally, when the two currents become very strong at the same time, their meeting gives rise to a rotary movement in the atmosphere; or, in other words, produces cyclones or revolving storms.

In general, the polar winds are cold, dry, and squally, while the tropical winds are warm, humid, and rainy. These circumstances permit us in many cases to foretell the change in the direction of the breeze. Thus, when the wind is blowing from the SW., and a small clear space is seen in the sky to the NW. or N., while at the same time the weather becomes cooler, and the deck, nettings, rigging, &c., dry off rapidly, we may be sure that the wind will haul rapidly to the NW. or N. These prognostications will be verified by a rise in the barometer. On the other hand, N., NE., and easterly winds will change to SE., S., or SW., soon after the horizon becomes overcast to the southward, while at the same time the weather gets warmer, and the deck, rigging, woolen clothes, hair, beard, &c., show the increased humidity of the atmosphere; these signs are accompanied by a falling barometer.

It is well known to mariners that the SW. wind never blows a gale until it has lasted for some time. On the other hand, it often happens that SW. gales haul to the NW. in quick, violent squalls, so that NW. gales spring up very suddenly, and often unexpectedly. Care should be taken to guard against violent shifts of the SW. gales to NW. by "lying to" on the starboard tack when it blows heavily from SW. If this precaution is neglected and the sudden shift catches a vessel "lying to" on the port tack, she will be taken aback and will run a very great risk of losing her masts.

It is evident, in spite of their apparent instability, that the variable winds follow a very well-marked, general law in their numerous changes of direction. They veer around the compass *with the sun*, or the same as the hands of a watch; that is to say, they blow successively from S., SW., W., NW., N., and so on. When, as an exception, they do not obey this general law of rotation, or when they haul, for example, from NW. to SW., or SSW., they are said to *back*, and under such circumstances vessels may be sure of bad weather; the horizon and the barometer should then be closely watched.

In the region of variable winds, as we have already said, the winds blow principally from a westerly direction, between NW. and SW. Near the southern limit, and from the thirty-seventh to the fortieth parallels, the mean direction of the wind appears to be west; and as higher latitudes are approached, that resultant generally changes to the southward and westward. It seems rational, then, as has been done by certain authors, to change the name of the "zone of *variable winds*" to "the *zone of general westerly winds*."

The SW. monsoon of the coast of Africa.—In referring to the table already given of the equatorial limits of the NE. and SE. trade-winds, between which we may as a general rule expect to find the

greatest number of calms and light airs, it will be seen that these limits gradually separate from each other in proportion as the west coast of Africa is approached. Thus, on the meridian of 22° 30′ west, the trade limits are about 3° apart the whole of the year, except in June, July, August, and September, when that distance is increased to a mean of about 9°. On the meridian of 27° 30′ it may be seen that, at the same time, the distance reaches a mean of about 8°.

On the other hand, the table of chances of calms as given for the months of July, August, and September, shows that at this time between the parallels of 5° and 10° N. (which constitutes the space between the two limits) the chances of calms are at a minimum. There are, successively, 0.6 per cent. and 8 per cent. of chances until the meridian of 30° 00′ W. is reached. Beyond this meridian the chances increase and become from 15 to 20 per cent. We will remark, that between the parallels of 10° and 15° N. (the space in which the limit of the NE. trades is found) the number of chances of calms is much greater than between the parallels of 5° and 10° N. In the first zone there is 11 and 13 per cent. of calms between the meridians of 20° and 30° west, instead of only 8 per cent., as between the same meridians in the second zone. On the other hand, there is but 3 and 2 per cent. of chances of calms between the same meridian in the zone comprised between the equator and 5° N., in which lie the limits of the SE. trade-winds.

These observations show that, viewing the subject in relation to the chances of calms, there is a great advantage to be gained *in the months of June, July, August*, and *September*, by *crossing the equator at a meridian farther to the eastward* than during the remaining months of the year. By an examination of the wind-charts, it will be seen that at the same season between the limits of the two trades and from the coast of Africa out to the meridian of 30° W., the prevailing wind is from S. a nd SW.

During the remaining months of the year (and even in July, August, and September, to the westward of 35° W.), between the limits of the two trades, the prevailing breezes are easterly, varying from SE. to NE., and inversely.

The general name of SW. monsoon of the coast of Africa is given to those winds which blow in June, July, August, and September, generally from SW. from the coast of Africa to the meridian of 35° W., and chiefly between the parallels of 5° and 10° north latitude.

At this season of the year, *between the parallels* of 5° and 10° N., there are the following chances of winds:

Between the coast of Africa and the meridian of 15° W., about 67 per cent. of SW. and 33 per cent. of S. E. winds. Between 15° and 20° W., about 6 per cent. of calms, 72 per cent. of S., and 22 per cent. of SW. winds. Between 20° and 30° W., about 8 per cent. of calms, 48 per cent. of S., and 44 per cent. of SW. winds. At the same time in

the zone between 0° and 5° N. and between 20° and 30° W., the chances are in favor of winds from S. and SE. We may expect 52 per cent. of S. and 46 per cent. of SE. winds, with only 2 per cent of calms.

Prevailing winds on the coasts and in the principal groups of islands, January, February, and March.*—*Between the equator and the African coast* the prevailing winds are from SE. to SW., between the meridians of 10° E. and 10° W. In the Bight of Biafra they are from SSW. to WSW. Along the coast from the Gaboon River to the meridian of 10° W., in the months of January and February, the *harmattan*† may blow from NE., but with very little force.

On the coast of Sierra Leone, to the westward of the meridian of 10° W. and to the southward of 10° N., there are 21 per cent. of calms; the prevailing winds are from NW., with occasional NNE. and SSW. breezes. There are also some chances of encountering the harmattan during the months of January and February.

Between 10° *N. and Cape de Verde* the prevailing winds are from NNE. and WSW. The chances of calms do not exceed 5 per cent. Finally, the harmattan may blow, in January and February, anywhere from ESE. to NNE.

About the Cape de Verde Islands there are 3 per cent. of chances of calms, and the prevailing winds are from NE., liable, however, to vary to NNW. or ENE. The harmattan occasionally in January and February.

From 15° *to* 20° *N., between the coast of Senegal and the meridian of* 20° *W.,* no calms at all, and prevailing wind from NNE., variable to NNW.

From 20° *to* 25° *N., between the coast and the meridian of* 20° *W.,* but 4 per cent. of calms, with the prevailing wind from ENE., frequently from N., and rarely from ESE. and WNW.

From 25° *to* 30° *N., and near the Canary Islands,* there are 3 per cent. of chances of calms; prevailing winds from NNE. and ENE.; occasional winds from SSW., WSW., and NW.

In January care should be taken to avoid heavy gales from SE. and SW., accompanied with rain.

In the neighborhood of the Madeiras there are 3 per cent. of calms, with variable winds, prevailing from NNW., NNE., and ESE. Look out for strong winds from S. and SW. and sometimes from NE. In March there are often NW. winds.

North of 30° *N., and to the straits:* No calms; prevailing winds from NNW. and NNE.

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*Nearly everything in this paragraph on the subject of winds is taken from the English admiralty pilot-charts.

†The *harmattan* is a cold, dry wind, ordinarily from E. or ENE., blowing in series of 3, 6, or 9 days, and usually from December to March. It is sometimes very strong off the coasts of Senegal and Senegambia, and as a general thing quite feeble off the coast of Guinea. We will point out the number of chances of its being felt on the coast between the Gaboon River and Madeira.

At the mouth of the straits : Violent southerly gales, which shift suddenly to W. and NW. These gales follow each other at short intervals. The heaviest squalls come from SW.

To the eastward of the straits : No calms; prevailing winds, westerly; occasional northerly breezes.

Coasts of Portugal and Spain from Cape St. Vincent to Cape Finisterre: Very variable winds; no calms. The SW. gales, accompanied by rain, are frequent in January and February. If they haul to NW. they continue to blow heavily, but without rain. If there is a period of calm after SW. winds, look out for bad weather. The gales are generally preceded by a swell from SW. or W.

Northern coast of Spain and the Bay of Biscay: Prevailing winds from SW. and W. Frequent NW. gales, both violent and persistent; they begin at SW., then pass to W., with an overcast sky. The N. and NNE. winds are severe, and accompanied by squalls of sleet and hail.

To seaward of Ouessant Island: The prevailing winds are from the westward, with 9 per cent. of chances of calms.

To seaward and west of Cape Clear (*Ireland*), between 50° and 53° N. and to 20° W., the prevailing winds are from SW. When SW. wind is strong and accompanied by rains, it often hauls to the NW., driving the clouds before it, clearing the sky and blowing with greater violence. When the SW. wind backs round to the eastward of south (SSE. or SE.), there will be a long spell of bad weather. The northerly and easterly winds are generally moderate and accompanied by fine weather. Calms are very rare, and are the forerunners of bad weather.

About the Azores and to the southward of this group, to 35° N., there are 11 per cent. of calms, with prevailing winds from NW. to NNE.; occasional winds from SE., SSW., and W. To the northward of this group up to 40° N. there are no chances of calms while the winds blow equally from the four points, NW., NE., SE., and SW.

Gulf of Saint Lawrence: Navigation closed by the ice.

To the eastward of Halifax and Nova Scotia : N. and NW. winds, with clear weather, prevail; the occasional easterly winds bring foggy weather with them.

Between the United States (from New York to Charleston) *and the Bermudas :* The weather is generally cool and dry. Near the Bermudas rotary gales or cyclones are frequently encountered, commencing at SW. and turning to NW., passing through W. On the other hand, on the American coast these same storms begin at NE. and turn to W., passing through NW. Between the gales easterly winds and calms of short duration are observed.

To the eastward of and near the Bahamas : Very few, if any, calms, the trades being interrupted by winds beginning at SW., and ending in NW. or N.

On the northern coast of Cuba : From 5 to 12 per cent. of calms; the trades being interrupted in January by winds from N. and SW.

On the southern coast: Land and sea breezes; the first are strong near the land.

On the west coast of Florida, from Cape Sable to Espiritu-Santo Bay (latitude 28° N.), there are 5 per cent. of chances of calm with prevailing northwesterly winds. From Espiritu-Santo Bay to New Orleans there are from 6 to 7 per cent. of calms; winds from SE. and SW., with a great deal of rain. The winds from SW. and W. are strong, and when they turn to NW. or N. they bring fine weather.

From New Orleans to the meridian of 95° *W.*, and on the coast, the prevailing winds are northerly. The southerly winds blow very strong and in squalls, sometimes lasting for three or four days. In February and March fogs are common off the mouth of the Mississippi River.

On the Mexican coast, between 22° and 28° N., heavy gales from E. and ESE., lasting for three or four days, are sometimes experienced. They generally haul round, and end somewhere to the northward.

To seaward of Vera Cruz and along the whole southern shore of the Gulf as far as Cape Catoche: Season of northers;* they are more frequent in January and February than in March.

In Hondurus Bay up to Cape Gracias the trades are interrupted by northerly winds. In January heavy winds from SW. to NW. may be expected.

Between Cape Gracias and Porto-Bello the trades prevail, with occasionally strong northerly winds.

In the Gulf of Darien occasionally very heavy NNW. and NNE. winds are felt; hazy weather.

From Cartagena to Chichibacoa (at the mouth of the Gulf of Venezuela) there are moderate trade-winds.

Between the peninsula of Paraguana and Margarita Island land-breezes are very rare.

On the coast of Jamaica there are 10 per cent. of calms, while the land and sea breezes are occasionally interrupted by northers. The sea-breeze sometimes blows all night.

On the coasts of Hayti the land and sea breezes prevail.

* During the dry season, from September 15 to March 15, the northers prevail, particularly in the Gulf of Mexico. Light, northerly winds prevail in September and October; heavy and continual in December, January, and February. In this period, from September to March, the winds blow moderately from the eastward, passing to SE., S., and SW.; they increase when turning to W., and become very strong when reaching NW. or NNW. They then turn to the northward, and die out at NNE. or NE. The approach of NW. or NNW. gales, which are frequent from November to February, are signalized by a great increase of humidity, and by the movement of the barometer, which, after being very low, begins to rise just before the bad weather. These gales last from three to four days, and are accompanied by very cloudy weather, and usually a large amount of rain. They are often preceded by a heavy, black cloud, which rises in the NW., and is seen, morning and evening, attaining a height of about 12° above the horizon, sometimes for three or four days before the gale commences.—(Kerhallet.)

On the northern coast of Porto Rico this is the season of tide-races. The trades sometimes blow with violence from N. or NW.

To windward of the Lesser Antilles, or Windward Islands: Season of tide races. The trades are established well to the northward, and very squally.

To leeward: Calms and light breezes.

At Barbadoes: Season of fine weather, and very dry weather.

Tobago and Trinidad Islands: Dry season, tidal races, with northerly winds.

On the coast of the mainland from the Orinoco River to the Maroni River (French Guiana): Season of rains and tidal races, squally weather, with sudden and heavy showers of rain.

On the coast of French Guiana: Rainy season (seven hours per day), 8 per cent. of calms; to seaward, E. and NE. breezes.

To seaward of the Amazon and off Maranham: Same kind of weather, rainy season, with NW. and SW. squalls.

In *April, May,* and *June. Between the equator and the coast of Africa,* comprising the Bights of Biafra and Benin, up to the meridian of 3° or 4° west longitude (Cape Three Points), the prevailing winds are from the southward and westward. The *tornadoes** blow from the SE. to NE., and have been known to blow from the NW.; the winds from seaward are strong, and when the tornadoes follow them very suddenly they will also be very strong. Rain falls in May.

* Tornadoes are sudden and violent storms lasting for an hour, an hour and a half, or longer, during which the wind shifts a great number of times. This style of squall is met with particularly on the African coast. To the southward of the equator they are not so extraordinarily strong, but to the northward are very violent. In either locality they are of frequent occurrence, especially at the end or beginning of the winter season. Some time before a tornado occurs peculiar clouds will be seen moving against the surface-wind. These clouds are dull copper-colored during the day and black at night, frequently furrowed with clear streaks, and piled or banked up to the northward and eastward. They gradually extend along the horizon and upward, slowly at first, forming a large arc of a circle, the edges of which are the more clearly defined in proportion as the coming wind will be the stronger. The surface-wind soon begins to fall, and then dies out very quickly; after a few seconds of calm the wind suddenly, and with greater or less violence, springs up from NE., and the storm bursts, attaining its greatest strength when it is three or four points (36° or 45°) above the horizon. The wind soon changes very suddenly from NE. to E. and SE., retaining the same strength, after which it begins to moderate upon getting to S., and is very feeble at SW., at which time the storm ends in rain. The heaviest tornadoes are those in which the wind is spent before the rain falls. Sometimes off the Gaboon coast, and in the Bight of Biafra, the tornadoes blow from NW. to W. and SW. (Kerhallet). The clouds preceding tornadoes often (from the translator's personal observation) appear to be pushing an immense roll of somewhat lighter cloud along its whole front, and the lightning plays very vividly, and apparently with great viciousness along the *roller*, and about the line of its intersection with the main cloud. In two cases noted in 1864 the storms did not burst, but were killed by very heavy rains. Every precaution should be taken, however, upon the appearance of these "tornado clouds."

From Cape Three Points to Sierra Leone: April and May, tornadoes; the rains commence in May and June; the SW. winds are fresh, and throw in a heavy swell; there are from 8 to 12 per cent. of calms, except in the vicinity of Sierra Leone, where there are about 17 per cent.

From Sierra Leone to Cape de Verde there are from 15 to 18 per cent. of calms. The winds blow from southward and from northward, hauling to NW. during the afternoon. Tornadoes in April and May; rains commence in May.

Cape de Verde Islands: The trades blow from NE. and E., becoming light as they haul to the eastward.

Coast of Senegal: Prevailing winds from NNW. to WNW.; occasional winds from ENE. No calms. Wind very feeble in June.

From 20° *to* 25° *north between the coast and* 20° *west* there are from 5 to 6 per cent. of chances of calms. Prevailing winds from NNE.; occasional from ENE. and SSW.

From 25° *to* 30° *north, and about the Canary Islands:* Winds predominating from NNE. To the northward of the Canaries the winds are from NNE. to NNW., while to the southward of the group there are calms and variable winds.

About Madeira: Prevailing wind from NNE., with only 2 per cent. of calms. In April very uncertain weather; in May and June fine weather, with well-established NE. winds.

To the westward of the straits: Only 3 per cent. of calms; SW. and ESE. winds, which blow very fresh about the change of the moon.

In the straits there are moderate winds from the westward and from the eastward, the latter being accompanied by rain in April and by fogs in June.

To the eastward of the straits there are 15 per cent. of calms, and adding the chances of NE., E., and SE. winds together, they amount to the same number as the chances of the SW. or W. winds.

From Lisbon to Cape Finisterre the prevailing winds are from the northward.

North coast of Spain and Bay of Biscay: The prevailing winds are from SW. to NW., generally moderate; rains.

About the Azores and to the northward of that group: Prevailing winds from NW. and NE.; occasional winds from SW. and SE.; no calms.

To the southward of the Azores the prevailings winds are SSW. to NW., and mostly from WSW. Occasional winds from NNE. and ESE.

NE. coast of Labrador: Prevalent winds from NW. to SW.

In the straits of Belle Isle: Icebergs are to be met with in June. All the winds, except those from N. or W., bring fogs with them.

In the Gulf of Saint Lawrence: Prevailing winds from the eastward. The southerly and easterly winds are accompanied by fogs. In April and May the NE. winds bring clear weather. Navigation impeded by the ice until May. In April the ice renders navigation very dangerous.

On the coast of Nova Scotia and to seaward of Halifax: Thick fogs or rain ordinarily accompany winds from seaward. N. and NW. winds bring clear weather. Heavy gales are rare in this season.

To the eastward of and about the Bahamas: Variable winds in the month of May.

Coasts of the Gulf of Mexico: North coast, *from Cape Saint Blas to New Orleans:* The trades, varying from NE. to E., and SE. and S., are sometimes interrupted by SW. winds.

From New Orleans to Galveston: Winds from N. and NE.; in April accompanied by fogs.

From Galveston to Tampico: Light winds from SE.; land-breeze at night.

From Tampico to Carmen Island: Occasional light northerly winds; rains, calms, squalls, and overcast or cloudy weather toward the latter part of May.

From Carmen Island to Cape Catoche: The trades are moderate; weather fine.

Between Capes Catoche and Gracias (Gulf of Honduras): Prevailing winds from ENE. The southerly winds, accompanied by squalls and calms, commence in June.

Between Cape Gracias and Porto Bello: Prevailing winds, NE. trades, interrupted near the land by SW. and W. winds, with squalls.

From Porto Bello to Cape Chichibacoa (at the entrance of Maracaybo Gulf): The trades blow with great strength from ENE., and, near the land, westerly winds are sometimes met with.

From Maracaybo (or Venezuela) Gulf to Trinidad Island: The trades are well established, and from the eastward breezes off the land are very rare.

Island of Cuba, north coast: Calms and variable winds in May; trades prevail from the eastward in April and June.

South coast: SE. squalls with cloudy weather interrupt the trades.

Jamaica: Trades; land and sea breezes. The latter often blow all night.

Hayti: Trades; land and sea breezes.

To the northward of Porto Rico and Saint Thomas: The trades are feeble at night.

To the southward: There is no land-breeze.

To windward of the Lesser Antilles: The trades are well established. This is the season of fine weather.

To leeward of the same islands: There are calms and light breezes.

To the SE. of Barbadoes: Rainy in the month of May. The trades moderate and become quite feeble in June.

Coast of the mainland; from the Orinoco to the Maroni River (French Guiana): Rainy in May and June; winds variable and squally. Off the coast NE. winds prevail.

Coast of French Guiana and *at the mouth of the Amazon:* The change of season occurs in May, and is accompanied by rains, variable winds, and frequent calms and squalls.

In *July*, *August*, and *September*, *between the equator and the African coast*, comprising the Gulf Biafra and the Bight of Benin, to the meridian of 3° or 4° W.: The prevailing winds SSW. No calms; continual rain with strong sea-breezes near the land; heavy swell from SW.

From Cape Three Points to Sierra Leone: Winds predominate from SSE., SSW., and S.; no calms. Rains, with fresh SW. winds, which throw in a heavy swell. The weather clears up in September, and the winds haul to the southward.

About Sierra Leone: There are about seven hours' rain daily.

From Sierra Leone to Cape Verde: Rainy season; SW. squalls; few calms. Wind generally prevails from SW. It varies to the southward and near Cape de Verde from the SSW. to NNW.

Cape de Verde Islands: The trades prevail from the NNE., blowing alternately with winds from SW. to SE. Squally weather with fogs; occasionally a tornado may be expected. This is also the season for tide-rips or races. Few calms to the northward, but great numbers of them to southward of the islands.

From Cape Verde to 20° *N., comprising Senegal:* Prevailing winds from NNW. to NNE.; no calms; tornadoes, followed by feeble SW. or WSW. breezes.

About the Canaries: As on the African coast, the prevailing wind is from NNE. To the northward of the Canaries, the winds are well established from NNE. to NNW.; *to the southward* and *close to the islands*, there are calms and variable breezes.

At Madeira: Prevailing winds from NNE.; few if any calms.

To the westward of the Straits of Gibraltar: There are 9 per cent. of calms, with variable winds, mostly from NNE. at first, and then from SE. Land and sea breezes on the Spanish coast.

In the straits: Winds from W. or E. The latter prevail in September; rain-squalls, with thunder.

To the eastward of the straits: There are 21 per cent. of calms, and about 45 per cent. of easterly and 35 per cent. of westerly winds.

From Lisbon to Cape Finisterre (*Spain*): The land is hazy or foggy, with NE. winds.

On the north coast of Spain and in the Bay of Biscay: There are, particularly in the month of August, heavy squalls and sudden shifts of wind from SW. to NW.

To seaward west of Cape Clear (*Ireland*): Prevailing wind is NW., with clear weather.

About the Azores and to the northward of that group, to the fortieth parallel: The prevailing winds are those from NE.; they blow occasionally from SE., SW., and NW., and there are but 4 per cent. of calms.

To the southward of the group: There are 8 per cent. of calms. The winds predominate from SSW. and WSW. and blow occasionally from WNW. and NNE.

On the NE. coast of Labrador: Prevailing winds from NW. to SW.; violent squalls in August, blowing form N. or NW., but of short duration.

In Belle Isle Straits: Fogs accompany all winds, except those from north or west. Icebergs should be looked out for.

Gulf of Saint Lawrence: Prevailing winds from SW. with frequent fogs. *In July and August*, thunder-storms, accompanied by very heavy rain-squalls; in *September*, NW. winds, with fine dry weather.

Coast of Nova Scotia: Thick fogs or rain accompany all winds from seaward. Gales are frequent toward the end of August.

To the eastward of and about the Bahamas: The trades usually blow somewhere between S. and E.; they are variable, and accompanied by squalls and heavy rains.

Coast of Florida (Appalachee Bay): Season of hurricanes, squally weather, SW. winds.

From New Orleans to Galveston: Navigation is bad in August and September, being exposed to squalls and hurricanes.

From Galveston to about the bar of Santander (23° or 24° north): Light but regular SE. breezes. Light breezes at night.

From Tampico to the Lagoon of Sta. Anna: Trades, established from ESE. to E. Land-breezes from S. or SW. Light breezes from NE. in August and September.

From Carmen Island to Cape Catoche: Strong sea-breezes during the day and land-breezes at night. Occasional NE. and SE. gales may be looked for in day-time.

From Cape Catoche to Cape Gracias (Gulf of Honduras): Winds from SE. and SW., accompanied by heavy squalls and calms.

Between Cape Gracias and Porto Bello: Westerly winds, uncertain weather, and heavy squalls, accompanied by rain.

From Porto Bello to Cape Chichibacoa: Westerly winds near the land; NE. winds outside. *In the Gulf of Darien*, variable winds, with SW. squalls.

Near the land, between Curaçoa and Margarita Islands: The trades blow from ESE. to ENE.

Near the land between the islands of Margarita and Trinidad, the land-breezes are very rare.

To the eastward of Trinidad: Rains and violent southerly squalls.

Island of Cuba, on the north coast (from Cape Staint Antonio to Havana): Squalls are met with some distance from the land. In the Saint Nicholas Channel, in the old channel, and up to Maysi Point, the trades are variable and interrupted by SW. winds and calms. *On the south coast*, between Pinos Island and Cape Cruz, there are calms and light breezes, with southeasterly squalls.

Between Cuba, Hayti, and Jamaica is a region of SE. winds and violent and dangerous squalls.

To the southward of Jamaica: Land and sea breezes, accompanied by calms, southerly winds, and heavy rains.

Hayti: Land and sea breezes are well established on the *north*, but irregular on the *south coast.*

To the northward of Porto Rico and the Virgin Isles: Trades, accompanied by calms; light SE. winds, with squalls.

To windward of the Lesser Antilles: The trades blow from E. and NE., with a few calms and light breezes.

To leeward: Light breezes and calms are more frequent.

At Barbadoes: The trades are interrupted by winds from W. and SW. Heavy rains.

From the mouth of the Orinoco to Cayenne: Rains in July; dry weather and moderate breezes in August and September. The prevailing winds from seaward are from NE. to SE. There are about 16 per cent. of chances of calms to the northward of Cayenne and Paramaribo or Surinam.

To the southward of Cayenne to the Amazon's mouth: Regular ESE. winds, with well-established, fine weather.

In *October, November,* and *December, between the equator and the coast of Africa,* comprising the Bights of Biafra and Benin, to the meridian of 1° or 2° W., prevailing winds are those from SW. Fogs form after sundown. Tornadoes in October and November; the harmattan in December.

From Cape Three Points to Cape Mesurado: Prevailing winds from SSW. and SSE. Tornadoes in October, harmattan in December.

To seaward of Sierra Leone: Persistent calms. (See the table of calms.)

To northward of the parallel of 9° or 10° north, to Cape de Verde: Southerly winds and rain; tornadoes. Harmattan begins in December.

Cape de Verde Islands: In October, winds from SSE. to SW., with squalls and fogs. In November and December the trades blow from NNE., N., or NNW. The harmattan blows in December.

From Cape de Verde to Cape Blanco (21° N.): Winds ENE. to NNW. Weather dry, nights cool.

Canary Islands: In October and November, trade-winds from NNE. to NNW. In December, winds from SE. and SW., with rains.

Madeira: In October, rains with winds turning from SE. to SW. and NW. In November and December, fine weather, with NE. winds, interrupted by occasional SW. gales.

Straits of Gibraltar: Westerly winds are more frequent than those from the eastward. In October thunder-storms may be expected. The NE. winds carry fogs to the coast of Africa. Calms are rare. (See the table.)

From Cape Saint Vincent to Cape Finisterre: SW. gales, bringing rain with them, are frequent in November and December. If they haul to NW. the wind continues to blow heavily, but the rain ceases. If, on the contrary, a calm follows a strong SW. wind, very bad weather may be expected. The gales are generally preceded and foretold by the swell.

North coast of Spain and Bay of Biscay: The winds prevail from SW. and westerly directions. Violent and persistent NW. gales are frequent; they commence at SW., turn to W., with gloomy, cloudy weather, and finally haul to NW.

To the westward of Cape Clear (Ireland): The winds prevail from SW. When they are strong and accompanied by rain, they frequently haul to NW., clearing the sky but blowing with increased strength. If they back to the southward or eastward, prolonged heavy weather may be looked for. In these localities the northerly and easterly winds are generally moderate. Calms are rare, preceding and announcing bad weather.

About the Azores: The chances of calms are but few at this season, being but 3 per cent. To the northward of the group, and up to the fortieth parallel, the prevailing winds are those from NW. to NE., and to the southward and as far as to the thirty-fifth parallel north, those from S. to WSW. Vessels running from west to east gain by passing south of the group.

Straits of Belle Isle (Newfoundland and Labrador): Fogs accompany all winds except those from NW. to W. Ice begins to form in October.

Gulf of Saint Lawrence: Strong NW. winds, with sleet, snow, and heavy frosts. Easterly gales bring in thick snow-storms. Navigation is partially closed in December.

Nova Scotia: On this coast N. and NW. winds, with clear weather, are prevalent. Fogs sometimes form with on-shore winds.

Between the United States (from New York to Charleston) *and the Bermudas:* In October there is generally fine weather. In November fine weather ceases, and rotary gales, very variable in force, begin to be experienced. In December the weather is generally cold and dry. During the last-named month, as was pointed out for January, February, and March, cyclones are frequently met with near the Bermudas, commencing at SW. and turning to NW. through W. On the contrary, near the United States coast, these same gales commence at NE. and haul through W. to NW.

Between the cyclones the prevailing wind is from the eastward, with short calm spells.

To the eastward of and near the Bahamas: The trades blow from N. to E., that is, from a northeasterly direction. They are interrupted, however, by winds from N., NW., and SW.

Florida (from Cape Sable to Espiritu Santo Bay): The prevailing, or NE. winds, are sometimes interrupted by SW. breezes, which throw in a heavy swell.

Florida (from Espiritu Santo Bay to the Alabama River): Hurricanes in October; prevailing wind from north and east.

From the Alabama River to Galveston: Winds from NW. to ESE., through E. The months of October and November are dangerous. Hurricanes and squally weather.

From Galveston to Tampico: Heavy gales from E. to ESE., lasting three or four days, and finally passing off at NW.; must be guarded against.

From Tampico to Carmen Island: Trades from NE., interrupted by northers, particularly in December. (See January, February, and March.)

From Carmen Island to Cape Catoche: Trades from NE. Northers in November and December, as in January, February, and March.

From Cape Catoche to Cape Gracias: Trades from NE., interrupted by SW. and NW. winds. Frequent gales from WSW., WNW., and N.

From Cape Gracias to Porto Bello: Westerly winds frequently take the place of the trades. After November the weather is the most pleastant, but at times moderate northers are felt. (Note in January, February, and March.)

From Porto Bello to Santa Marta and to Cape de la Vela: The on-shore winds from NE. and E. and replaced, near the land, by westerly breezes. In the gulf the winds are variable, with squalls from SW.

From the Paraguana Peninsula to the island of Margarita: Land-breezes are rare, the prevailing winds being those from E. and NE.

Between Cuba and the Bahamas: The trades blow from between N. and E. or from a general northeasterly direction. They are interrupted by *northers*, which are persistent and turn to NW. (For the *northers* see note for January, February, and March.)

South coast of Cuba: Land and sea breezes; strong winds from N. and NE.

Jamaica: Rain sometimes falls on the north coast. On the south coast, in December, the sea-breeze at times blows all night.

Hayti: Land and sea breezes. On the south coast the sea-breeze is from E. to SE.

Porto Rico: Season of tide-races. Fresh W. or NW. breezes sometimes blow on the northern coast.

Lesser Antilles: Season of tide-races. *To the eastward* the trades are well established from the northward, but squally. Calms at night; no land-breezes. *To the westward*, moderate number of calms and light breezes.

To the eastward of Barbadoes: Variable winds, with squalls, as also the trades. In December the trades are well established, and accompanied by rains.

Island of Trinidad: Uncertain weather in October.

From Trinidad to Cayenne: About the middle of November, rains and sometimes squally weather. In December, tide-races, with northerly winds.

From Cayenne to the line: The change of the wind from ESE. to ENE. takes place in November. The weather is finer at this season than in May, when the opposite change of season takes place.

Currents of the North Atlantic.*—*Equatorial current* —The equatorial current crosses the Atlantic from east to west, between the parallels of from 2° to 5° N. and from 5° to 10° S. It may be regarded as a leeward motion of the surface-waters, from a colder to a warmer region, occasioned by the action of the SE. trade-winds. According to the charts, this current commences somewhere in the locality of the island of Annobon, which lies a little to the southward of the equator and between the meridians of 2° and 8° E. The temperature of the water, at the surface, in the eastern portion of the stream, during a great part of the year, is several degrees below that of the Guinea current, whose direction is nearly opposite. This difference in the temperatures is an evident proof that the equatorial current has its origin at a parallel remote from and much colder than the equator. Moreover, in the description of the South Atlantic currents, we shall see that there is one with a general set to the NW., along the coast of Africa, from the mouth of the Congo River, and even from the Cape of Good Hope, which joins, and in part feeds, the equatorial current.

The equatorial current attains its maximum volume and velocity during the summer of the northern hemisphere. Between the African coast and the meridian of 15° W., the velocity is at its maximum in June and July. To the westward of that meridian the maximum is reached between July and October. But at all times, since the equatorial current is a leeward movement resulting from the action of the winds, its velocity at different seasons of the year should depend upon the force of the prevailing winds which have produced it.

The northern limit of this current, or the line which separates it from the Guinea current, which latter runs parallel, but in an opposite direction, to the first, is very clearly marked in the space comprised between the meridians of Greenwich and 23° W. This limit varies slightly from one season to another. Thus, on the meridian of 20° W., the point of separation of the two currents is on the fifth parallel of north latitude, in October and November, and on the parallel of 2° 30′ N. in March and April. Taking another meridian, that of 10° W., for example, the line of separation is, generally speaking, on the parallel of 2° 30′ N., even on the meridian of Greenwich it is on the parallel of 1° 30′ N.

Annobon Island, near the African coast, is always in this current, or, in other words, the current always washes that island; and, on the contrary, the Guinea current always flows around Prince's Island, while St. Thomas, lying between the two above-named islands, is, according to the season, washed by either the one or the other.

* The following remarks upon the currents are deduced almost entirely from the English admiralty pilot-charts.

From Annobon to about the meridian of 15° W., the mean temperature of the surface water is as follows: From December to March, 78° to 82°; from March to July, 82° to 72°; from July to October, 72° to 75°; from October to December, 75° to 78°.

To the westward of the meridian of 15° W. the mean temperature of the neighboring waters diminishes sensibly for each season, so that the equatorial current gradually loses its first distinctive character of being, comparatively, a low temperature current at all seasons.

Between Annobon and the meridian of Greenwich, the westerly velocity of the equatorial current varies from 12 to 36 miles per day.

Between the meridian of Greenwich and 10° W., the velocity varies from 14 to 50 miles per day, the greatest velocity being observed between the line and the northern limit of the stream.

Between 10° and 20° W. the velocity, *below the line*, varies from 12 to 50 miles, and *above the line*, from 18 to 79 miles per day.

Between 20° and 30° W. the velocity of the current, *below the line*, to 6° S., varies from 10 to 67 miles per day, and *above the line*, to 3° N., from 13 to 88 miles.

Between 30° and 35° W. the velocity of the current, between the equator and 5° S., varies from 12 to 46 miles; it sometimes reaches even 60 miles per day a little to the westward of and about the Rocas. *To the northward of the line*, to 2° N., the velocity is only from 19 to 31 miles per day.

Between 35° and 40° W., *below the line*, the direction of the current is nearly parallel to the trend of the coast, varying from W. to WNW., the velocity being from 10 to 60 miles in 24 hours.

As a general thing, near the coast, and in the vicinity of Cape St. Roque, the current attains its greatest velocity from March to September, being from 20 to 60 miles per day; while from October to February it rarely exceeds 12 to 18 miles.

To the northward of the line as far as 3 N. the current sets WNW. with a velocity of 12 to 36 miles.

To the westward of 40° W., and up to the Lesser Antilles, the waters of the equatorial current follow the American coast in a general NW. direction. The northern limit of the current is about the intersection of the meridian of 40° W., and the parallel 3° 40′ N.; 45° W. and 4° 40′ N.; 50° W. and 7° N.; and 55° W. and 10° N. Beyond these points the general westerly movement of the waters of the Central Atlantic, which we shall call the *drift of the trades*, commences to combine with the NW. current along the coasts of Guiana. The combined waters enter the Caribbean Sea, then the Gulf of Mexico, by way of the Yucatan Channel, sweeping around the Gulf with the sun, and debouch into the Atlantic under the name of "the Gulf Stream."

To return to the currents on the northern coast of Brazil, we remark that the equatorial current is only felt from a distance of 10 or 12 leagues off the coast up to the northern limit as already assigned.

To the northward of this limit, *and as far as the parallel of* 10° *N.*, the waters form, *in summer and autumn, a counter-current to the eastward,* which finally joins the Guinea current, as we shall point out further on.

This counter-current between the meridians of 40° and 53° W. at times attains a velocity of 60 miles per day. To the eastward of the meridian of 40° W. the velocity decreases, so that between the meridians of 30° and 20° W. it has a velocity of only 30 to 15 miles per day. On the coast of Brazil and for a distance of 10 or 12 leagues seaward the waters move only under the influence of the tides.

The velocity of the current off the Brazilian coast, from 12 to 75 or 70 leagues off shore, varies from 18 to 60 miles per day, setting NW.; between 40° and 45° W. it varies from 20 to 99 miles per day, setting between NNE. and N.¼ W., from the meridian of 45° to that of 50° W. From 50° to 55° W., between 12 and 60 leagues off shore of Guiana, the direction of the current is NW., and its velocity varies from 19 to 68 miles per day. Between 55° and 61° W., and about the same distance off shore, the current sets NW., with a variable velocity of from 15 to 57 miles per day.

Amazon River.—The waters of the Amazon attain their maximum height in the month of May, after a gradural rise lasting about six months. They then fall for about the same period, and attain their minimum height in November. The current of the Amazon (the ebb current) first sets to the ENE., then bends to the N. and NW., and mingles with the equatorial current, the velocity of which it tends to increase. The change of color produced by the current of the Amazon extends for a long distance to the northward and westward.

To the northward of Cape do Norte (a little north of the mouth of the Amazon), the velocity of the current of the flood, from January to April, is double that of the ebb. In the month of May the two currents are about equal. From July to October the current of the ebb is the stronger, and from November to January they are again equal.

Westerly current or drift in the trade-wind region.—A general westerly current exists throughout the whole central part of the North Atlantic Ocean, and may be considered as an immense drifting movement of the surface-waters produced by the pressure of the trade-winds.

Between the parallels of 10° *and* 20° *N.*, and from the meridian of 25° W. to the Lesser Antilles, this current attains the following extreme velocities: On the meridian of 30° W., 9 to 30 miles per day; meridian of 40° W., 8 to 25 miles; meridian of 45° W., 8 to 29 miles; meridian of 50° W., 10 to 30 miles; meridian of 55° W., 10 to 36 miles; and on the meridian of 60° W., from 10 to 24 miles per day.

Between the parallels of 20° *and* 30° *N.*, and on the meridian of 30° W., the velocity of the westerly current varies from 6 to 20 miles per day; on the meridian of 35° W., from 7 to 16 miles; on that of 40° W., from 6 to 20 miles; on 45° W., from 5 to 20 miles; 50° W., from 8 to 26

miles; 55° W., from 6 to 19 miles; 60° W., from 8 to 20 miles; 65° W., from 8 to 21 miles, and on 70° W. it varies from 6 to 20 miles per day.

Between the parallels of 30° *and* 35° *N.*, and on the meridian of 45° W., the velocity of the westerly current varies from 8 to 16 miles; on the meridians 50° W., from 12 to 27 miles; 55° W., from 8 to 24 miles; 60° W., from 8 to 36 miles; 65° W., from 12 to 20 miles; and on 70° W., from 8 to 24 miles per day.

The above is a terse but correct description of this great drifting movement of the waters, which, on the western side of the Atlantic, is limited on the W. and N. by the Gulf Stream moving in an opposite direction; while in the eastern part of the Atlantic its limit is shown, and at the same time increased by the large current setting down the coasts of Europe and Africa, and terminating in the Gulf of Guinea.

Current of the Caribbean Sea.—In the Caribbean Sea the general direction of the current is to the westward. The waters of the equatorial current, after having washed the coasts of Guiana and Brazil, pass between Trinidad, Tobago, and Granada with a velocity of from 24 to 72 miles per day in this narrow passage, and which is maintained for some time along the coasts between Trinidad, Margarita, and Curaçoa. Even in the eastern part of the Caribbean Sea, and at 40 leagues or more from the shores of America, the westerly current is found, though much more feeble, viz, 8 to 30 miles per day.

This general movement of the surface-waters, in the central part of the Caribbean Sea, is produced and increased by the drifting current of the trade-winds which traverse the chain of the Lesser Antilles, or Windward Islands. Between the meridians of 70° and 80° W., and in the zones comprised between the parallels of 12° and 15° N., the velocity of the westerly current is from 12 to 60 miles per day. It becomes still less as the south coasts of Jamaica and Hayti are approached.

A counter-current, setting successively to the S., SE., E., and ENE., runs along the coast of America, extending a distance of about 12 or 15 leagues off shore, from Cape Gracias to Cartagena, including the Gulf of Darien. We may remark here that this counter-current of water is analogous to the counter-current of air which was pointed out as existing in the same locality, where westerly winds frequently blow, while the trades prevail a little off shore. A counter-current to the eastward is also experienced in the Gulf of Honduras, following the land very closely from the head of the bay to Cape Cameron.

Beyond the meridian of 80° W. the waters flow toward the NW. to enter the Gulf of Mexico by way of the triangular space between the island of Cuba and the peninsula of Yucatan. The velocity of the NW. current in this western part of the Caribbean Sea varies from 12 to 43 miles in the broadest, and from 14 to 62 miles per day in the narrowest part, viz, at the entrance to the Gulf.

In certain parts of the Caribbean Sea, at new moon, and about the time of the autumnal equinox, there is sometimes an easterly current

encountered, setting directly to windward. This anomaly has been observed, particularly a short distance from the southern coasts of Cuba, Jamaica, Hayti, and Porto Rico. A current of over a knot an hour sets to the eastward along the south coast Hayti, in-shore, and upon consulting with the master of an *Atlas* steamer, that has been running to Aux Cayes for years, he stated that there is a strong current, and that it often troubles him going to Jacmel when running by log.

Current of the Gulf of Mexico.—The waters which flow into the *Gulf of Mexico* by way of the Yucatan Channel, with a velocity varying from 14 to 62 miles per day, divide into two currents, one of which follows the coast of Cuba and sets to the NE. outside of the Colorados Banks, with a velocity of from 14 to 31 miles per day. Off Havana it sets ENE. toward the Florida Channel, with a velocity of from 20 to 72 miles per day. The other and more important current flows around the Yucatan peninsula, at a distance of about 50 leagues off shore, setting successively to the NW., velocity of 20 to 60 miles to the westward, velocity of 18 to 30 miles, and then to the SW., making a large circuit with the sun, and following the Mexican coast, but at a distance of 10 to 40 leagues off shore. Thus, in front of Tampico, the current sets north with a velocity of 12 to 45 miles; off Rio del Norte it sets NNE., velocity 12 to 14 miles, and a little farther north, and more off shore, it sets NE., with a velocity of from 26 to 31 miles per day. After setting east across the meridian of 88° W., and between the parallels of 25° 30′ and 28° N., the stronger part of the current flows to the SE. with a velocity of 24 to 36 miles per day, and finally, when off Havana, rejoins the other part of the original current, which is there setting to the E. and ENE., with a velocity, as we have already said, of from 20 to 72 miles per day.

The temperature of the sea-waters in the Gulf of Mexico, is 73° in winter, 77° in spring, 83° in summer, and 80° in autumn.

Currents among the Greater Antilles and Bahama Islands.—To the southward of the Great Antilles, as we have already said, the current sets to the westward, with the exceptions before mentioned.

To the northward and eastward, and to windward of the Virgin Islands, the current sets NW.; velocity, 18 miles per day. On the north coast of *Porto Rico* it sets to the westward; between *Porto Rico* and *Hayti*, to the northward and NNW. Between *Navidad Bank*, *Silver Bank*, and the *Mouchoir Carré* (north of Hayti), as also between the *Caicos* and *Mariguana Island*, the currents set to the W. and SW.

On the north coast of Hayti, toward the W., between Hayti and Cuba, to the S. and SW. On the northern coast of Cuba to the W. and NW.; and then flows to rejoin the Gulf Stream. About 15 or 20 leagues off shore, and to the NE. of the chain of the Bahamas, there is a current with a velocity of 10 to 15 miles per day, setting SE. and extending from the Bahama Banks to just off the banks of Caicos and Mouchoir Carré. In the NW. and NE. Providence Channels, the current

comes from the Florida Channel, and flows to the eastward (first ESE., then ENE.), following the windings of the passages.

Gulf Stream.—This current, compared by many authors to a river traversing the ocean, debouches with a high velocity from the Florida channels, and carries to the northern part of the Atlantic Ocean a vast quantity of warm water, coming from seas whose temperature is very high. The presence of this stream of warm water undoubtedly explains in a satisfactory manner the fact that the atmosphere is very warm (about 70°) in the region between the parallels of 35° and 45° N. in the North Atlantic, while to the northward and to the southward of that zone it is much cooler, being in fact only 64°.5.

The waters of the Gulf Stream are of an indigo-blue color, and it is generally quite easy to distinguish the line of separation from the adjacent waters of the Atlantic Ocean. In fine weather the limits of the Gulf Stream are easily recognized by the line of currents and eddies, and in the latitudes which are high enough to cause evaporation by the fogs, &c., which are frequently produced there. In observing the temperature of the surface of this current, particularly off the coast of the United States, it has been observed that the axis of the current, where the velocity attains its maximum, is also the line of the highest temperature. The waters become colder very rapidly to the westward of this line; and in approaching the coast, where there is a counter-current coming from Davis Straits, there is found a difference of 8°, and even of 17° in winter, between the waters of the Gulf Stream setting NE. and those of the counter-current setting to the SW. The Gulf Stream to the eastward of the line of highest temperatures becomes cooler much more gradually. A similiar series of observations has been made on the changes of temperature between the surface and the waters at a considerable depth below it.

Between the central part of the Gulf Stream and the coast, the temperature diminishes so rapidly that the line of demarkation has received the name of the *cold wall*. A difference of 30° in the temperature has been observed between two points situated only a few ship's lengths apart. The high temperature of the water is not *always* a certain indication that one is in the Gulf Stream proper, because frequently the waters of the current overflow like those of a river, and form a counter-current, running along its borders in an opposite direction. Thus to the eastward and southward of the Gulf Stream there is a general current often observed, setting to the SW. with a velocity varying from 7 to 24 miles per day. This counter-current, as it approaches the Bahama Banks, branches to the southward, then to SE., and finally joins the current we pointed out as existing to the northward of the chain of the Bahamas. The waters thus move in a semicircle against the sun, first on the right bank of the Gulf Stream, and then to the northward of the Bahama Islands.

The line of demarkation between the hot and cold waters varies considerably, and the limit of the current itself also varies, but in a smaller degree. Under certain circumstances the Gulf Stream is deflected from its regular course; it is closer to or farther from the coast of America, according to the pressure exerted in one direction or the other by the gales from NE. and or SE. NW. and SW. From this fact we account for the following anomaly which is sometimes observed, viz, the Gulf Stream flowing where the water is comparatively cold; and inversely this current not existing at times in positions where the temperature of the water would lead one to expect it.

It is also seen that that part of the Gulf Stream which traverses the Atlantic from west to east, undergoes an oscillating movement toward the north or toward the south, following the changes of the sun's declination, and regulated in the same manner as the changes of the limits of the trade-winds. The extreme northern limit is attained in September, while the extreme southern limit is reached in the month of March, at which season the mass of water of the Gulf Stream is probably less.

The velocity of the stream varies according to the season, attaining its maximum toward the summer solstice or at the beginning of autumn. At the outlet of the Gulf of Mexico and at the entrance of the Florida Channel, the velocity varies from 2½ to 4 miles per hour; in the narrow parts of the channel the greatest velocity observed in the month of August is 5 miles per hour. Farther on, between the parallels of 30° and 33° N., the velocity of the current setting NNE. varies from 30 to 97 miles per day; from 33° to 36° N. it is from 30 to 90 miles per day, setting NE. ¼ N.; on the meridian 71° W., between 36° 30′ and 39° N., it again reaches 24 to 95 miles per day, setting ENE.; on the meridian of 67° W., and between the parallels of 36° and 40° N., it varies from 24 to 64 miles per day, setting E.; on the meridian of 63° W., between 37° 30′ and 41° 30′ N., the velocity varies from 20 to 65 miles per day, setting E. ¼ N.; on the meridian of 58° W. it again reaches from 20 to 60 miles per day, after which the velocity diminishes very rapidly. Thus it is only from 12 to 36 miles per day, and setting E., on the meridian of 48° W. when between the parallels of 38° 30′ and 40° N.; finally it is but 19 miles per day setting E. on the meridian of 40° W. and between 38° 30′ and 46° N.; however, it has been observed, exceptionally, that the velocity has reached 4 miles per hour in the month of August, at the intersection of the parallel of 41° N. and the meridian of 45° W. To the eastward of the meridian of 35° W. the waters of the Gulf Stream spread out and are lost over a considerable space, still moving, however, to the NE., and their influence is felt on the coasts of Ireland and Norway.

At the outlet of the Gulf of Mexico the current reaches its maximum temperature, 85°; this is about 5½° higher than that of the waters of the ocean on the same parallel. To the southward of the banks of Newfoundland, the temperature of the current is from 19° to 30° higher

than that of the adjacent waters. The following table gives the temperature of the warmest zone of the Gulf Stream, in different localities and in each season:

Locality.	In winter.	In spring.	In summer.	In autumn.
	°	°	°	°
Florida Channel	77	78	83	82
Off Charleston	75	77	82	79.5
Off Cape Hatteras	72	73	80	76
Southeast of Nantucket Shoals	67	68	80	72
South of Nova Scotia	62	67	78	69

The regions traversed by the Gulf Stream are remarkable for their high temperature and for squally and uncertain weather, especially in winter. When the winds from W. or SW. blow a gale, the heat of the atmosphere reaches its extreme, while the weather beyond the northern and eastern limits of the Gulf Stream is excessively cold. In bad weather the sea is heavy and chopping, and is the cause of many disasters to vessels.

Consequently the routes which would profit by the Gulf Stream, in a passage from the Gulf of Mexico to Europe, have the grave inconvenience of exposing vessels to very heavy weather, with the likelihood of sustaining severe damages.

The *Greenland current* flows from the Polar Sea, along its eastern coast, and sets to the SSW. with a velocity of from 10 to 15 miles per day; upon arriving at the southern extremity of Greenland, it bears away to the westward, flows around Cape Farewell with a velocity of 10 to 18 miles per day, and sets to the NW., following the western coast of Greenland.

There is another current, setting to the SSE., which issues from *Davis's Strait*, and covers the space extending from the coast of Labrador to within 30 or 40 leagues of that of Greenland; it flows with a velocity of from 8 to 24 miles per day past the parallel of 59° N.; on that of 56° N. the velocity is 10 to 36 miles, set SE.; on that of 49° N., velocity 8 to 20 miles, set S.; this latter was observed between Newfoundland and the meridian of 41° W. On this current icebergs drift to the southward, particularly in the spring; the temperature of its waters is very low.

A part of the waters of this current from Davis's Strait enters the Gulf of Saint Lawrence, by the straits of Belle Isle, with a velocity of 12 to 48 miles, and flows out between the Island of Cape Breton and Newfoundland with a velocity of 12 miles per day.

These waters then join those coming from the eastward of Newfoundland, and which, finding their movement south arrested by the barrier of the Gulf Stream, turn to the SW. and W. The velocity of the cur-

rent on the parallel of 46° 40′ N., near Cape Race, is from 12 to 48 miles per day, setting SW.; at 20 leagues to the eastward of the cape the current only reaches 12 to 24 miles per day, up to the eastern edge of the bank; at 46° 40′ N. and 42° W., the set is SW., and velocity from 10 to 18 miles per day.

To the southward of Newfoundland, and near the coast, the set is to the westward and the velocity 12 miles per day; farther off shore, when nearing the Gulf Stream, the velocity to the westward is from 10 to 36 miles per day.

On the coast of Nova Scotia, the cold current sets SW. with a velocity of from 12 to 24 miles per day. To the southward of Cape Sable and off shore of Cape Cod, the current sets S., velocity 10 to 20 miles per day; between Cape Cod and Cape Hatteras, the current follows the windings of the coast with a velocity of 10 to 15 miles per day, and is felt, at a slight distance from the shore, with the same velocity, as far south as Florida.

Between Newfoundland and Cape Hatteras, particularly at the beginning of winter, the temperature of the surface-waters of this current is often 30° lower than that of the adjacent waters of the Gulf Stream, and at other seasons this difference is from 14° to 25°.

Bay of Biscay and Rennel current.—This current, setting to the eastward with a velocity of 24 miles per day, follows the northern coast of Spain, makes the circuit of the Bay of Biscay, and sets to the NW. when off the coasts of Brittany and the mouth of the English Channel. This current, after making the circuit of the Bay of Biscay, is then called the "Rennel current," and its velocity is about 10 miles per day.

Current setting eastward in the eastern part of the Atlantic.—Between the parallels of 40° and 50° N., and to the eastward of the meridian of 38° W., there is a current setting to the eastward with a velocity of from 10 to 48 miles per day; on the meridian of 33° W. the velocity is from 6 to 30 miles, and it is from 6 to 24 miles per day on the meridians of 28° and 23° W. On the meridian of 18° W., and between 45° and 50° N., the velocity is still 6 to 24 miles; but between 38° and 43° N., and the meridians of 13° and 18° W., it varies from 12 to 30 and 8 to 36 miles per day. This current is increased by the Gulf Stream and the current from Davis's Strait, and its movement is probably accelerated when westerly winds prevail.

Between the parallels of 50° and 60° N., and at about the meridian of 33° W., the movement of the surface-waters is toward the east, with a velocity of from 10 to 24 miles. At the meridian of 23 W., the current flows toward the coast of Scotland, in a general northeasterly direction and with a velocity of from 8 to 24 miles per day.

Off shore, and to the westward of Cape Clear, the current sets due east, velocity varying from 8 to 24 miles. Between the parallels of 30° and 40° N., and the meridians of 18° and 23° W., the current generally sets to the southward, with a velocity of from 7 to 28 miles per

day; between the same parallels, but the meridians of 10° and 18° W., it sets SE., velocity from 7 to 25 miles. To the eastward of the meridian of 10° W., the current sets to the eastward, velocity from 6 to 18 miles; finally, in the straits of Gibraltar, the mean velocity of the easterly current varies from 48 to 72 miles per day.

Current of coast of Africa, Morocco, and Senegal.—This current flows down the African coast from north to south. Its direction, between the parallels of 10° and 30° N., is along shore; from this it may be seen that the set has more southing in it the nearer one is to the coast, and that it deflects gradually to the westward the farther to seaward.

Thus, between the parallels of 20° and 30° N., and on the meridian of 22° W., the direction of the current is SW., velocity 7 to 30 miles; on the meridian of 20° W., the direction is SSW., velocity 6 to 9 miles; and along the shore the direction is S. and SSW., velocity from 10 to 24 miles. Between 10° and 20° N., on the meridian of 22° W., the direction of the current is SW., velocity 5 to 16 miles; on the meridian of 20° W. and to the northward of Cape de Verde, the direction is SW., velocity from 8 to 24 miles; and to the southward of Cape de Verde, the direction is south, velocity from 8 to 13 miles.

Guinea current.—This current has an easterly set, and prevails, more particularly, from Cape Roxo to the Bight of Biafra, between the coast of Guinea and the parallel of 3° or 4° N. Its western limit, that is to say its origin, is somewhere about the meridian of 23° W.; but at all times, as was said regarding the equatorial current, a current with an easterly set may be expected, in summer and autumn, between the parallels of 4° and 8° N., and about the meridian of 53° W., which flows to and unites with the current of the Gulf of Guinea.

Between Cape de Verde and Sierra Leone, and for a distance of 50 or 60 leagues off shore, the currents change with the winds according to the season. From June to September the winds are from SW., with squalls, and there is a current setting to the N. and NE. From October to May, with the wind from N. and NE., a current is observed, setting to the SE., which flows to join that of the Gulf of Guinea.

Between Sierra Leone and Cape Palmas the same thing is observed. From May to October the current sets NW., with the winds more to the southward and southward and westward, and sets SE., when the winds are more to the westward than to the southward and westward. In November, the current generally sets NW.; and from December to May, to the SE.

The current of the Gulf of Guinea close inshore has a velocity of about half a knot per hour, while at a distance of a few miles from the coast its velocity is from 2 to 3 knots. It reaches its maximum velocity off Cape Palmas, where it has been observed to be 3 miles per hour to the eastward. To the southward of Cape Three Points, the easterly velocity varies from 18 to 52 miles per day.

During the season of the *harmattan*, from December to February, the Guinea current is sometimes arrested near the land, and replaced by a counter-current to the westward; the heavy tornadoes have a similar effect.

The Guinea current is, at all seasons, warmer than the equatorial current; its temperature off Fernando Po is always above 80° Fahr.

Icebergs. The currents from Greenland and Davis's Straits bring down great quantities of floating ice, especially in spring time, and the presence of icebergs in the western part of the Atlantic Ocean constitutes a very serious danger to navigation. We shall give, for the different times of the year, the extreme limits to the eastward and to the southward of Newfoundland where these may be encountered.

Eastern limit of icebergs in July and August: 51° N. and 43° W.; 50° N. and 42° W.; 49° N. and 42° W.; 48° N. and 41° W.; 47° N. and 40° W.; 46° N. and 39° 30′ W.; 45° N. and 38° 30′ W.; 44° N. and 38° 20′ W.

Eastern and southern limits of icebergs in May and June: 52° N. and 51° W.; 51° N. and 48° W.; 50° N. and 46° W.; 49° N. and 44° 35′ W.; 48° N. and 43° 30′ W.; 47° N. and 43° W.; 46° N. and 42° 30′ W.; 45° N. and 42° W.; 44° N. and 41° W.; 43° N. and 40° W.; 42° N. and 39° 10′ W.; 41° N. and 39° W.; 40° N. and 40° W.; 39° 30′ N. and 42° W.; 39° N. and 44° W. Ice may be met with on the parallel of 39° N. between the meridians of 44° and 46° W.; then the limit trends farther north, cutting 39° 30′ N. at 48° W.; 40° N. at 50° W.; 41° N. at 53° W., and 42° N. at 55° W.

Eastern and southern limits within which large quantities of floating ice may be met with from March to July: 51° 30′ N. and 52° 30′ W.; 51° N. and 51° W.; 50° N. and 48° W.; 49° N. and 47° W.; 48° N. and 46° W.; 47° N. and 45° W.; 46° N. and 45° W.; 45° N. and 45° W.; 44° N. and 45° W.; 43° N. and 47° W.; 42° 30′ N. and 48° W.; 42° N. and from the meridian of 50° to that of 51° W.; after which the limit trends to the northward, and cuts 43° N. at 52° 30′ W., and 44° N. at 54° W.

Use of the barometer.—It is indispensable to know, in order to make use of the barometer, the *mean barometrical height*, or the *mean level* of the mercury at the position of the observer.

The following is a table, according to Maury, of this mean barometrical height, for each parallel of latitude in the North Atlantic Ocean, from the equator to 70° N.:

North latitudes.	Height of barometer.	North latitudes	Height of barometer.	North latitudes.	Height of barometer.
	Inches.	°	*Inches.*	°	*Inches.*
Equator.	29.918	25	30.119	50	30.001
5°	29.910	30	30.182	55	29.989
10°	29.941	35	30.162	60	29.878
15°	29.989	40	30.111	65	29.839
20°	30.052	45	30.052	70	29.800

The following is another table taken from the English admiralty pilot-charts, giving the *mean barometric height*, for each month of the year, between the equator and 50° N.:

Mean barometric height in the North Atlantic Ocean.

North latitudes.		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
	From.—	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
To eastward of meridian of 40° W.	50° to 45°	30. 158	30. 119	29. 882	29. 961	29. 922	30. 001	30. 040	30. 040	30. 001	29. 922	30. 079	30. 040
	45° to 40°	30. 158	30. 119	30. 079	30. 001	30. 001	30. 040	30. 158	30. 079	30. 040	30. 001	29. 961	30. 040
	40° to 35°	30. 197	30. 197	30. 158	30. 040	30. 079	30. 196	30. 197	30. 158	30. 119	30. 079	30. 001	30. 040
	35° to 30°	30. 237	30. 158	30. 197	30. 158	30. 119	30. 197	30. 237	30. 197	30. 158	30. 158	30. 040	30. 158
	30° to 25°	30. 237	30. 158	30. 119	30. 158	30. 197	30. 237	30. 197	30. 158	30. 079	30. 119	30. 040	30. 158
	25° to 20°	30. 079	30. 119	30. 079	30. 079	30. 119	30. 158	30. 079	30. 079	30. 040	30. 079	30. 001	30. 040
	20° to 15°	30. 001	30. 140	30. 040	30. 001	30. 040	30. 040	30. 001	30. 001	30. 001	30. 001	29. 961	30. 001
	15° to 10°	29. 961	29. 961	30. 001	29. 961	30. 001	29. 961	29. 961	29. 922	29. 922	29. 961	29. 961	29. 961
	10° to 5°	29. 882	29. 922	29. 922	29. 922	29. 922	29. 922	29. 961	29. 961	29. 961	29. 922	29. 922	29. 922
	5° to 0°	29. 882	29. 922	29. 882	29. 882	29. 922	29. 822	29. 961	29. 961	29. 961	29. 961	29. 922	29. 922

Between the equator and the parallel of 25° or 30° N. the barometer serves: 1st. To indicate when a vessel is about to enter or to leave the region of the trade-winds; or that it is about to enter or leave the regions of the equatorial or tropical calms. In fact the barometer is from .80 to 1.00 inch lower in the equatorial calm-belt than it is in the trades; and it rises from .60 to .80 of an inch when passing from the trades into the region of tropical calms. 2d. To notify the approach of cyclones.

On board vessels anywhere between the equator and 25° or 30° N., when the barometer is observed to fall at the rate of .02 of an inch per hour, and to reach a point from .2 to .3 below the mean level, precautions should be taken against the approaching storm. When it falls at the rate of .03 inch per hour, and gets from .4 to .5 below the mean level, the indication is that the center of the cyclone is but two or three hundred miles distant; with an hourly fall of .05 inch to a point .78 inch below the mean level, the vessel will be under treble reefs, and the center of the storm about 150 miles distant; with a fall of .07 or .09 per hour and a level .98 inch below the mean, the vessel will be under storm-sails, with the center about 75 miles distant; finally, even in the center of cyclones, the level reached by the mercury will be only 1.5 or 1.9 inches below the mean.

When the barometer begins to rise again, at first very quickly and afterward with a more moderate movement, the center of the storm will be traveling away from the ship and the danger will be over.

To the northward of the parallel of 25° or 30° N. the barometer generally announces, about twelve hours in advance, every change of the wind both in direction and in force; gales are foretold twelve hours at least, and sometimes even twenty-four hours in advance.

Generally speaking, the easterly winds, hauling to the SE. and S., lower the barometer; when they reach SW. the barometer ceases falling; the winds then hauling to W., NW., and N. cause the barometer to rise; and when the winds reach NE., that rise is checked. We can

say, then, that in general there is a high or rising barometer with northerly and a low or falling one with southerly winds.

When the barometric level remains *stationary*, that is, neither rises nor falls, for five or six hours, changes in either the force or direction of the wind need not be apprehended.

If the barometric level *oscillates*, that is to say, rises and falls alternately from .03 to .05 of an inch for the space of half a day, the weather will be uncertain. If it rises moderately, from .03 to .07 of an inch in five hours, either less wind or colder and drier weather may be looked for.

If it falls gradually from .03 to .07 of an inch in five hours, more wind or warmer and damper weather may be expected.

As a general thing, if the height remains stationary, at .15 to .19, or even .39 to .47, of an inch above or below the *mean level*, the weather will be steady and moderate; from the northward in the first case, and from the southward in the second.

It is very rarely that the barometric height reaches .59 to .78 of an inch or more, above or below the mean level, except during or just before very bad weather; that is to say, a great deal of wind.

Nevertheless, it must not be taken as a principle that, because the barometer is either very high or very low, it is about to blow harder.

It is better to know this more certain precept: *It will blow a storm whenever the barometer rises or falls very suddenly.*

It is best, then, in observing the barometer, to note not only if it is above or below the mean level, but particularly to take account of the parts of an inch it has risen or fallen during the watch, the whole morning, or a few hours. In this last consists the true source of information.

Every moderate movement of rise or fall (.05 inch in four hours) indicates moderate weather, while, on the contrary, every sudden movement (.15 to .19 in five hours, or .47 to .78 of an inch in twenty-four hours) announces plenty of wind. The barometer being very high (.59 to .78 of an inch or more above the mean level), with northerly winds, a sudden fall, accompanied by rise of the thermometer, indicates that the wind will back with great force to the southward.

The barometer being very low (.59 to .78 of an inch or more below the *mean level*), a sudden rise, with a falling thermometer, announces a change of wind from the SW. to the NW., and with a northerly gale.

In winter, a sudden fall of the barometer below the mean level and the thermometer toward freezing-point, indicates snow.

Finally, according as the rise or fall of the barometer is more or less rapid, the weather predicted is more or less close at hand, and will last a longer or a shorter time.

It is equally well known that the barometer announces cyclones in the higher latitudes, as it does in the torrid zone; reference may then be made to what has previously been said, taking care, however, to diminish the barometric heights .19 to 39. of an inch, in order to deduce the same prognostications. In our latitudes the barometer may, near the center of a cyclone, fall 2 inches below the *mean level.*

CHAPTER II.

OBSERVATIONS ON THE PRINCIPAL ROUTES ACROSS THE NORTH ATLANTIC OCEAN.

Routes from New York to the English Channel and to Liverpool.—In a general sense, the quickest route from New York to Europe would naturally be to follow the course of the Gulf Stream, so as to take advantage of that favorable current throughout its whole length, thereby sailing almost upon the arc of a great circle. But, by taking this route, very heavy weather is likely to be encountered about the time of the equinoxes, and from July to October. And for smaller vessels, as well as those which are not in first-rate condition, it would be much more prudent to take a route farther to the northward, keeping outside of the Gulf Stream more or less during the season, and at the epochs which were mentioned above.

The route which we propose is one of those studied out with the greatest care by Maury, and we think we cannot do better than simply to indicate the different points of crossing, as recommended by him, for each month of the year. It is understood, of course, that after laying out the route proposed to be taken, every endeavor should be made to follow it, provided the wind and weather permit; and, in case it has to be departed from, too great anxiety should not be shown in trying to regain it at any hazard. The route laid out should only be regarded as a model, which is supposed to combine the most favorable chances, and it must be remembered that very nearly the same conditions of wind and weather will be found at short distances on either side of it. The pilot-charts which are used in establishing the most favorable routes for crossing the ocean present the régime of winds for each square of 5 degrees or 100 marine leagues of the ocean, and for the different seasons of the year.

The following tables give the longitude west of Greenwich:

Route in January.		Route in February.	
North latitudes.	West longitudes.	North latitudes.	West longitudes.
° ′	° ′	° ′	° ′
40 28	74 00	40 27	74 00
40 28	70 00	40 45	70 00
42 02	65 00	41 42	65 00
43 33	60 00	43 13	60 00
43 33	55 00	44 42	55 00
45 03	50 00	44 42	50 00
45 03	45 00	44 42	45 00
45 28	40 00	45 00	40 00
45 27	35 00	46 26	35 00
46 30	30 00	47 50	30 00
47 55	25 00	49 13	25 00
47 55	20 00	49 13	20 00
49 17	15 00	Vessels bound to Liverpool { 50 00	15 00
Vessels bound to Liverpool { 50 00	12 20	{ 50 50	10 00
{ 50 38	10 00	Vessels bound up the Channel { 49 30	10 00
Vessels bound up the Channel { 49 17	10 00	{ 49 30	5 00
{ 49 36	5 00		

Route in March.		Route in April.	
North latitudes.	West longitudes.	North latitudes.	West longitudes.
° ′	° ′	° ′	° ′
40 27	74 00	40 27	74 00
40 27	70 00	40 27	70 00
40 00	65 00	42 00	65 00
42 45	62 30	42 00	60 00
42 00	60 00	43 31	55 00
43 31	55 00	45 00	50 00
43 31	50 00	46 21	45 00
43 31	45 00	46 27	40 08
43 31	40 00	46 27	35 00
43 31	35 00	46 27	30 00
45 00	30 00	47 52	25 00
46 27	25 00	49 14	20 00
46 27	20 00	49 14	15 00
47 52	15 00	Vessels bound to Liverpool { 49 14	10 00
Vessels bound to Liverpool { 50 00	11 45	{ 49 30	5 00
{ 50 44	10 00	Vessels bound up the Channel { 50 00	13 06
Vessels bound up the Channel { 50 00	10 00	{ Cape Clear.	10 00
{ 49 40	5 00		

Route in May.		Route in June.	
North latitudes.	West longitudes.	North latitudes.	West longitudes.
		From Sandy Hook	
° ′	° ′	° ′	° ′
40 27	74 00	40 08	73 00
42 00	70 00	41 13	70 00
41 34	65 00	42 25	65 00
43 06	60 00	42 45	60 00
44 36	55 00	44 15	55 00
44 36	50 00	45 43	50 00
44 36	45 00	47 10	45 00
44 36	40 00	48 33	40 00
45 00	35 00	49 54	35 00
45 00	30 00	51 13	30 00
45 00	25 00	51 13	25 00
48 25	20 00	51 13	20 00
48 25	15 00	51 00	15 00
48 25	10 00	50 40	10 00
Vessels bound up the Channel { 50 16	15 00	To the Channel.	
{			
To Liverpool	10 00		

Route in July.		Route in August.	
North latitudes.	West longitudes.	North latitudes.	West longitudes.
° ′	° ′	° ′	° ′
40 27	74 00	40 27	74 00
40 27	70 00	40 00	70 00
42 00	65 00	39 12	67 30
43 30	60 45	39 12	65 00
43 30	55 00	39 12	62 30
44 59	50 00	40 00	60 00
44 59	45 00	41 34	55 00
45 40	40 00	43 06	50 00
47 06	35 00	44 36	45 00
47 06	30 00	45 00	44 26
47 06	25 00	48 08	40 00
48 29	20 00	48 00	35 00
Bound for Liverpool 49 50	15 00	48 00	30 00
50 30	10 00	48 00	25 00
48 29	15 00	48 00	20 00
Bound for the Channel . 48 29	10 00	48 00	15 00
49 00	To the Channel.	Bound to Liverpool 49 22	10 00
		For the Channel..... 49 30	5 00

Route in September.		Route in October, November, and December.	
North latitudes.	West longitudes.	North latitudes.	West longitudes.
° ′	° ′	° ′	° ′
40 27	74 00	40 27	74 00
40 00	72 15	40 30	70 00
40 49	70 00	40 30	65 00
40 49	65 00	45 00	50 00
40 49	60 00	47 30	40 00
42 22	55 00	48 45	30 00
42 22	50 00	48 45	20 00
43 53	45 00	49 00	15 00
45 22	40 00	Bound for Liverpool.... 50 00	10 00
46 48	35 00	At Liverpool.	
48 12	30 00	Bound up Channel 49 15	10 00
Bound for Liverpool.... 49 35	25 00	49 20	5 00
49 35	20 00		
50 33	15 00		
50 33	10 00		
45 22	35 00		
45 22	30 00		
46 48	25 00		
Bound up Channel..... 46 48	20 00		
48 12	15 00		
48 12	10 00		
49 34	5 00		

The tables of routes which we have given are all taken from Maury, except that for the last three months of the year, which are not in the edition which we have seen. (Translation of Veneechout.)

The distance to be run to reach the mouth of the Channel, when following the preceding directions, is about 3,200 miles, which will be made in the mean time of twenty-three days by sailing-vessels of ordinary speed. The best passages are usually made in the month of June. We may also recommend the same routes to auxiliary steamers wishing to make as quick a passage as possible, without, at the same time, expending a large amount of coal. The fires need not be lighted, except with calms or light head breezes, and by the aid of steam the passage may be shortened about 10 per cent.

When a steamer desires to make the best time possible, the route to be taken is that which approaches nearest the arc of a great circle.

Cyclones will be foretold by the appearance of the weather and of the sea, and particularly by a rapid fall in the barometer to .78 to .98 of an inch below the *mean level*, and the order in which the wind shifts. The direction in which the center of the storm moves varies from ENE. to NNE. In all cases, *when facing the direction from which the wind blows, the center of the storm will be eight points to the right.* When the wind blows from between ESE. and SSE., and the barometer falls rapidly, the vessel is then in the path of the center of the cyclone, that is to say, in the very worst position possible; in this case it is necessary either to run before the wind to the northward or to get the ship on the starboard tack. Supposing it to have been impossible to avoid the center of the storm, when it shall have passed the vessel, a very sudden hauling of the wind to WNW. and NNW. will be experienced. Of course if the precaution, as pointed out by us, has been taken of keeping on the starboard tack, there will be much less danger of being caught aback by the sudden shift, with a corresponding decrease of danger to the masts. When on the track of the cyclone the barometer generally falls .02 to .04 of an inch per hour, when the center is 300 miles distant; .03 to .05 of an inch with the center 150 miles distant, and may fall .09 of an inch per hour with the center 75 miles away from the vessel.

Icebergs should be looked out for very carefully. They may be met with during the months of January, February, and March between the meridians of 45° 20′ and 55° 00′ W. and north of the parallel of 42° 30′ N.

During the months of April, May, and June there is danger of encountering them between the meridians of 41° and 57° W., and to the northward of the fortieth degree north latitude. At this season the ice sometimes gets as far down as 39° N., between the meridians of 43° and 46° 10′ W. In July, August, and September, icebergs may still be met with between the meridians of 50° and 60° W. to the northward of the parallel of 41° N., and between the meridians of 38° and 50° W. to the northward of the parallels of 41° 30′ and 42° 30′ N.

Routes from the Channel and Liverpool to New York (northern passage). The passage from the English Channel to New York is both difficult and disagreeable, especially in winter. The most direct route favorable to vessels bound from New York is naturally very unfavorable when returning to that place, it being then necessary to work against the winds and current; and these difficulties are increased by the fogs, ice, and storms to which vessels are exposed when nearing Newfoundland and the continent of America. We will add that, in these localities, where the horizon is often hazy and the weather overcast, care must be taken to allow for the rapid changes in the variation of the compass. The resulting dangers of this situation may be diminished by the use of our nautical tables. Be that as it may, in presence of these data it is more than ever necessary, before deciding upon

the route to be followed, to take into account the seaworthiness as well as the sailing qualities of the vessel about to undertake the voyage.

Two routes may be recommended, according to circumstances. The first, called the *northern route*, will be taken principally in winter, from October to March. It is, at all seasons, very good for strong sailing-vessels of good speed, as well as for auxiliary steamers which are able to stand up well under canvas. The second, called the *southern route*, will be chosen, particularly during the fine weather season, from April to October; and at all times by vessels wishing to avoid bad weather or unable to work rapidly to windward, either under sail or steam.

The northern route recommended by Maury will be found pointed out for each month of the year in the tables we shall now give, and which have been taken from his nautical instructions. (Longitude reckoned from Greenwich.)

Route in January.		Route in February.		Route in March.		Route in April.	
N. latitudes.	W. longitudes.	N. latitudes.	W. longitudes.	N. latitudes.	W. longitudes.	N. latitudes.	W. longitudes.
° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
49 30	5 00	49 00	10 00	49 30	5 00	49 30	5 00
49 30	10 00	47 38	15 00	50 00	6 54	49 30	10 00
49 30	15 00	47 38	20 00	50 49	10 00	49 30	15 00
48 08	20 00	47 38	25 00	50 00	13 00	46 06	20 00
46 45	25 00	47 38	30 00	49 30	15 00	45 00	21 34
45 18	30 00	46 12	35 00	49 30	20 00	44 46	25 00
45 18	35 00	46 12	42 00	49 30	25 00	45 00	30 00
45 18	40 00	46 12	45 00	46 05	30 00	44 46	35 00
43 49	45 00	44 44	50 00	46 05	35 00	44 46	40 00
43 49	50 00	44 44	55 00	46 05	40 00	44 46	45 00
42 19	55 00	43 15	60 00	46 05	45 00	44 46	50 00
40 46	60 00	41 44	65 00	46 05	50 00	43 16	55 00
40 46	65 00	40 44	70 00	45 00	54 00	41 43	60 00
40 46	70 00	40 29	74 00	44 37	55 00	41 43	65 00
40 27	74 00	.....	.... ..	43 08	60 00	40 27	70 00
.....	.. ....	.....	.....	41 36	65 00	40 27	74 00
.....	.....	.....	.....	40 02	70 00	.....	.....
.....	.....	.....	.....	39 37	71 00	.....	.....
.....	.....	.... ..	.....	40 27	74 00	....	.....

Route in May.		Route in June.		Route in July.		Route in August.	
N. latitudes.	W. longitudes.	N. latitudes.	W. longitudes.	N. latitudes.	W. longitudes.	N. latitudes.	W. longitudes.
° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
50 50	10 00	48 18	10 00	49 40	5 00	49 40	5 00
50 50	15 00	44 52	15 00	48 18	10 00	48 20	10 00
50 50	20 00	41 13	20 00	48 18	15 00	44 55	15 00
50 50	25 00	39 39	25 00	44 50	20 00	43 25	20 00
50 50	30 00	39 39	30 00	44 50	25 00	41 54	25 00
49 30	35 00	39 39	35 00	44 50	30 00	41 54	30 00
46 08	40 00	39 39	40 00	44 50	35 00	41 54	35 00
44 41	45 00	39 39	45 00	44 50	40 00	41 54	40 00
44 41	50 00	39 39	50 00	44 50	45 00	41 54	45 00
44 41	55 00	39 39	55 00	44 50	50 00	41 54	50 00
43 11	60 00	41 13	60 00	43 20	55 00	40 20	55 00
41 39	65 00	41 13	65 00	41 48	60 00	38 44	60 00
40 05	70 00	40 28	70 00	40 14	62 00	40 20	65 00
.....	.....	.....	.....	40 14	70 00	40 20	70 00
.....	.....	.....	.....	.....	.....	40 20	74 00

Route in September.						Route in October, November, and December.	
N. latitudes.	W. longitudes.	N. latitudes.	W. longitudes.	N. latitudes.	W. longitudes.	N. latitudes.	W. longitudes.
° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
49 30	5 00	40 18	30 00	39 42	50 00	49 30	5 00
46 09	10 00	40 18	33 00	39 42	55 00	47 00	20 00
45 00	11 38	39 42	35 00	40 39	58 00	45 00	40 00
44 00	15 00	39 42	40 00	38 45	65 00	42 30	50 00
44 00	20 00	39 42	45 00	40 20	70 00	41 00	60 00
40 18	25 00	.....	.... ..	.....	.....	40 20	70 00

The *northern route*, as given by certain other authors, leads still farther to the northward. They advise steering WNW. when leaving the Channel, then west between the parallels of 47° and 52° N., keeping farther to the northward toward the close of the year than during any other season. Having arrived at about the meridian of 36° or 38° W., it is recommended to steer to cross the meridian of 60° W., between the parallels of 42° and 43° N. From this last place lay the course for the port of destination, being careful to pass well to seaward of the bank to the southward of Sable Island, on account of the fogs and the SW. currents existing in that locality.

It is well known that the Gulf Stream crosses the Atlantic, in winter, below the parallel of 40° N., and does not flow toward the NE. until after having passed the meridian of 40° W.; consequently, by taking the northern route as given by us, this contrary current is entirely avoided, while at the same time the Greenland current, flowing SW. near Newfoundland, is favorable. This route has the further advantage of being very nearly the arc of a great circle, as well as passing far to the northward, where the degrees of longitude are much shorter. It may be taken, in October, November, and December, by large steamers and sailing-vessels with auxiliary steam-power. At all other seasons it has the disadvantage of carrying vessels through a region where icebergs are quite common. (See further, on this subject, the close of the preceding paragraph, as well as remarks on icebergs, p. 40.)

We here repeat that good vessels, either sailing or auxiliary steam, wishing to make the voyage under sail alone, should undertake, if exceptional circumstances do not prevent them, to follow the routes indicated in the tables for each month of the year.

Route from the English Channel and Liverpool to New York.—As we have already said, the southern route may be taken, particularly in summer, from April to October, and is the better one at all times for vessels fearing the very heavy northern weather, or being unable to work rapidly to windward either under sail or steam. It also permits a visit to either Madeira or the Canaries, without any sensible increase of the time of crossing.

We shall divide the instructions for this *route* into two parts; the first being from the *English Channel to the trades;* and the second, *from the trades to New York.*

The Channel to the trades.—The best points of crossings for vessels bound from the Channel to the region of the trades vary for each month of the year.*

In January, the parallel of 45° N. should be crossed at the meridian of 12° W.; that of 40° N., at 15° W., being careful to avoid getting to the eastward of the meridian of 15° W. after having passed to the southward of 40° N. Leaving 40° N. and 15° W., the course is about SSW., so as to pass to the westward of Madeira and to cross 27° N. at the meridian of 20° W.; at which time an entrance will be about to be made into the NE. trades. From this point the course should have more westing in it, so as to cross 24° N. at the meridian of 28° W. It is only by running on the parallel of 24° N., or even that of 22° N., that there will be any certainty of the winds being well established from the eastward.

In *February*, when leaving the Channel, it is generally necessary to work against persistent westerly winds. Every endeavor should be made to cross the parallel of 45° N. as far west as 13°, or even 15° W. The parallel of 40° N. should then be crossed at 15° W., so as to avoid the very unfavorable zone comprised between 40° and 45° N., and the meridians of 10° and 15° W.; cross 35° N. at about 18° W., passing to the westward of Madeira; then the parallel of 30° N. at 20° W.; after which continue due south to find the trades. The parallel of 24° N., or even lower, will have to be reached before a vessel can stand freely to the westward, with winds well established to the eastward.

In *March*, it will suffice if the parallel of 45° N. is crossed at 13° or even 12° W., but not any farther to the eastward. Then cross, in succession, the parallels 40° N. at 15° W.; 35° N. at 17° W., and 30° N. at 20° W.; thus running through the favorable zone comprised between 35° and 30° N., and the meridians 15° and 20°W. The remainder of the route is the same as during the preceding month.

In *April*, cross the parallels of 45° N. to the eastward of 11° W.; 40° N. between the meridians of 13° and 15° W., but nearer 15° than 17° if it is possible. Then the parallel of 30° N. should be crossed at 18° or even 20° W. From this latter point the course begins to enter the trade-wind region, and should be laid to the SW. in such a way as to reach 25° N. at 28° W., after which a free course may be run to the westward on the parallel of 25° N.

In *May* and *June*, cross 45° N. at 12° W., 35° N. at 17° W., 30° N. at 20° W., and then continue as in April.

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*The instructions given here for this first part conform to those published in Holland by the Observatory of Utrecht, which were translated into French by Lieutenant M. L. Helloco, of the imperial navy.

In *July*, and if SSW. or S. winds are met with when quitting the Channel, stand to the westward when waiting for the winds to haul to W. and WNW. Advantage should be taken of every slant to make anything to the SSW., so as to gain a favorable position, which will be attained by crossing 45° N. between 10° and 11° W. Continue the SSW. route, beating, if necessary, to cross 40° N. to the westward of the meridian of 14° W.; favorable chances will then most probably be found for crossing the zone comprised between 40° and 35° N. and 15° and 20° W.; pass to the westward of Madeira, and cross 30° N. between 18° and 19° W. From this position the trades will be favorable for making a good run to reach 25° N. at 30° W., beyond which meridian the course should be due west on the parallel of 24° 30′ N., being careful not to get to the northward of 25° N., as, by doing so, there is danger of losing the trades.

In *August*, when between the parallels of 50° and 45° N., vessels will find their chances for making southing very unfavorable, as the prevailing winds are contrary, mostly from SW. They will be forced to cross 45° N. at the meridian of 10° W.; they should be careful not to get to the westward of the meridian of 17° W., as the weather will be most unfavorable there. Cross 40° N., between 14° and 15° W.; 35° N. at 16° W.; and 30° N. at 20° W., passing to the westward of Madeira; after this proceed as in the previous month.

In *September*, cross 45° N. at 12° W.; 40° N. between 14° and 15° W.; 35° N. between 16° and 17° W.; and finally 30° N. at 20° W., passing to the westward of Madeira; then continue the route as in the months of July and August.

The route which we have given passes sufficiently far from the coast of Portugal to avoid the frequent calms which exist at this time of the year in the zone limited by the parallels 45° and 35° N., and the coast and the meridian of 14° W.

In *October*, when quitting the Channel, and between the parallels 50° and 45° N., very heavy weather may be looked for from SSW. to NNW.; vessels will be forced to cross the parallel of 45° N. between 12° and 13° W.; and that of 40° N. at 15° W. From this point, and in case of head winds, make short tacks, so as to cut the parallel of Cape St. Vincent between the meridians of 15° and 20° W.; and that of 30° N. about 19° W. In the vicinity of Madeira calms and rains will be found in October, with winds veering from SE. to NW. through W. In November the weather will be fine, with the winds often from NE. The passage from the Channel to the trades will probably be long, difficult, and laborious.

The trades should be found soon after passing 30° N. and 19° W., and with them the course may be run to cross 25° N. at 23° W.; and 22° or 23° N. at 33° W.; after which a true west course should be steered, being careful to keep to the southward of the parallel of 25° N.

In *November*, prevailing SW. winds may be looked for on the coast

of Portugal; it is necessary then to stand to the westward in such a way as to cross 45° N. somewhere outside of 12° W., if possible; then cross 40° N. to the westward of 16° W.; after which steer to cross 35° N. to the westward of 20° W., or at 20° W. if it is the best that can be done, and finally cross 30° N. at 20° W. From this position the trades should be felt, with which the passage may be made as in the preceding month.

In *December*, lay a course, when leaving the channel, to cross 45° N. at 10° W.; 40° N. between 14° and 16° W.; 35° N. at 17° or 18° W., and 30° N. at 19° W. From this latter position steer with the trades as in October and November.

The trades to New York.—The preceding detailed directions will enable vessels to gain the regions of the trades with great ease, and to steer a west course with all certainty. In winter the routes lead in a rather roundabout manner, but in summer they are shorter, and may be made in comparatively quick time. Further, a call may be made at Madeira without any serious inconvenience; and, finally, the safety of the route and facility of navigation will be found a good compensation for any loss of time.

In *January*, *February*, and *March*, after having made the proper amount of westing, with well-established trades, between the parallels of 24° and 22° N., vessels should, when on the meridian of about 60° W., begin to lay a course for their port of destination in such a way as to cross the meridian of 70° W. on the parallel of 27° N. They may then run toward New York in such a manner as to reach 34° N. on the meridian of about 72° W. About this locality cold, dry weather will be found, as also circular storms, beginning at SW. and turning to W. and NW., in the vicinity of the Bermudas, but which, on the American coast, begin at NE. and turn to NW. and to W. These series of storms are separated by easterly winds and calms of short duration.

In *April*, *May*, and *June*, the westing should be made on the parallel of 24° or 25° N., but not to the northward of 25° N. Northing should begin to be made about the meridian of 58° W.; crossing 60° W. at 27° N.; 68° W. at 30° N.; and from this latter point the run to New York can easily be made.

In *July*, *August*, and *September*, westing should be made in a sailing-vessel on the parallel 24° or 24° 30′ N.; commence trending to the northward at 60° or 61° W. Cross 30° N. at 68° W., and lay the course for New York. At this same season, an auxiliary steamer may steer WNW. after arriving at the meridian of 55° 10′ W.; if she encounters calms, which will be very probable, she can use her steam.

In all cases vessels should pass to the southward of the Bermudas, where the weather is clear and the sea smooth; while to the northward squalls and fogs are frequent. Sudden and violent gales of winds are to be feared near this group, particularly in July. Moreover, during this whole season, but especially in August and September, great care

should be taken on account of cyclones; a strict watch should be kept on the barometer and the appearance of the weather, particularly from the meridians 46° and 48° W. to New York. Between the parallels of 25° and 30° N., cyclones travel toward the NNW.; then between 30° and 33° N., they generally advance toward the north; and, finally, beyond 33° N. their track trends first to NNE. and then to NE. When in the trades, where the barometric level is almost stationary in ordinary weather, a fall of .19 to .38 inch below the *mean level* should be sufficient to attract attention; if it attains .47 to .59 inch, one may be sure of being several hundred miles from the center of the cyclone; a fall of .59 to .78 inch below the *mean level* will correspond to about three reefs in the topsails, and with a fall of .98 inch below the *mean*, a vessel will surely have to lie to. At the center of the cyclone, the fall may reach 1.58 to 1.76 inches below the *mean level.* Beyond the limit of the trade zone the fall of the barometer should be from .19 to .39 inch greater, particularly at the commencement, in order to indicate the same condition of wind and weather. Further, if heavy easterly winds are felt between 25° and 33° N., or if, after having passed the parallel of 33° N., heavy SE. winds are experienced, and at the same time a fall of .01 inch per hour of the barometer is noted, the vessel may be certain of being about 300 miles from the center of the storm and right in its track; a fall of .03 to .05 per hour indicates a probable distance of 150 miles from the center; finally, the fall per hour may reach .07 to .09 inch. With these indications, a change of wind may be expected from E. to W. in the first case, and from SE. to the NW. in the second.

If, when running nearly before the storm to the northward with the wind SE., or NW. with the wind E., it is found to be impossible to avoid the center of the cyclone, vessels should "lie to" on the *starboard tack* in order to escape being caught aback by the shifts of wind. In all cases, *when facing the direction from which the wind blows, the center of the cyclone will be eight points to the right.*

In *October*, *November*, and *December* the westing should be run down on the parallel of 22° 30′ N., avoiding any northing until the meridian of 55° W. is reached; then steer to cut the parallel of 25° N. at the meridian of 60° W.; 30° N. at 65° W.; 35° N. at about 69° W.; and from the latter position steer for New York.

The precautions which we recommended to be taken in August and September, the season in which cyclones are most frequent, should be repeated here. The revolving storms are to be feared, in *October*, after leaving the meridian of 48° W. As we said before, avoid passing to the northward of the Bermudas. In November, fine weather ends. In December, the weather is generally cold and dry, and bad weather, similar to that in January, February, and March, may be expected.

Route from New York to Gibraltar.—In *January*, *February*, and *March* sailing-vessels or auxilliary steamers should make all their longitude on 40° or 41° north latitude, with winds generally favorable and

few calms, provided they keep constantly to the northward of the parallel of 40° N. until the meridian of 20° W. shall have been passed. From this position, steer for the point at which it is desired to make the land. At this season of the year Cape Trafalgar is usually chosen.

In *April*, *May*, and *June* sailing or auxiliary steam vessels should steer so as to cross 40° N. at 70° or 69° W., and then steer due east between 39° and 40° N. Keep a bright look for icebergs from the meridian of 50° W. to that of 40° W.; pass to the northward of the Azores, so as to avoid the frequent calms which prevail to the southward of those islands. After having passed the meridian of 25° W., lay a course to cross the parallel of Cape Trafalgar or Spartel, at 10° W., and then steer due east, with winds which are nearly always favorable.

In *July*, *August*, and *September* follow the route just given. At all times, after passing the meridian of 25° W., steer so as to cross the parallel of Trafalgar at 10° W. Beyond this meridian calms are often experienced, as also winds well away from the northward, so that the land is made oftener at Cape Trafalgar than at Spartel.

At this season of the year (particularly in July and August), in the western part of the Atlantic Ocean, a lookout must be kept for cyclones, whose track is generally to the NE. (See routes Liverpool to New York, p. 46–48.)

In *October*, *November*, and *December*, steer in such a manner as to cross 40° N. at 68° or 70° W., and regain the parallel of 36° N. or even 35° 30′ N. at 50° W. Run down all the longitude about on the parallel of 36° N. without getting below 35° N. Between the meridians of 43° and 30° W. the winds are mostly from SE., which will be avoided by having taken the precaution of passing the zone at a higher latitude. Beyond 30° W. a good run may be made, passing to the southward of the Azores, where generally calms are not experienced; but they may be met with within the meridian of 20° W. The most frequent winds, at this season, at the mouth of the straits, are those from NW. to NE. Land is usually made at Trafalgar.

Route from Gibraltar to New York (by the trade-winds).—For sailing-vessels bound from Gibraltar to New York the best route is unquestionably by way of the trades.

Leaving the straits, a course should be laid to pass between Madeira and the Canaries, after which a SW. course should be steered to reach the parallel on which the westing may be run down, with well-established trade-winds.

In *January*, *February*, and *March*, when leaving the straits vessels may encounter heavy gales from SW., hauling to NW., and succeeding each other at short intervals; the heaviest squalls are from SW.; great attention should be paid to the barometer. In the neighborhood of Madeira, and from there to the Canaries, strong S. and SW. winds are likely to be met with, as also exceptionally some from NE. In March, NW. winds are often experienced.

If a call is made at the Canaries, vessels should look out for gales from SE. and SW. When in the trades run down the longitude between the parallels of 22° and 24° N., and end the voyage as directed in remarks Liverpool to New York, pp. 46–48.

In *April*, *May*, and *June:* When leaving the straits at this season, moderate weather with few calms will generally be encountered. It will be necessary to cross the parallel of 35° N. as soon as possible, at the meridian of 9° or 10° W. From that position a course should be laid to pass to the westward of the Canaries (stopping there if necessary), profiting by the trades to cross 25° N. at 25° W.; then steer due west between 24° and 25° N., and finish the passage as pointed out in remarks Liverpool to New York, pp. 46–48.

In *July*, *August*, and *September:* At this season there are at least 10 per cent. of chances of calms to the westward of the straits; so that when leaving them the great care should be to get to the westward, there being no necessity for anxiety about making to the southward. The meridian of 10° W. should be crossed as quickly as possible, as beyond that more favorable winds and less calms will be found. This recommendation applies particularly to sailing-vessels. Having gotten to the westward of 10° W., lay a course to cross 25° N. at 30° W., and run down the westing on 21° or 24° 30′ N. Finish as pointed out in remarks Liverpool to New York, pp. 46–48.

In *October*, *November*, and *December:* At this season the route by way of the trades is very long. When leaving the straits, steer to cross 34° N. at about 11° W.; and from there lay a course to pass near the Canaries, where NNE. or NNW. winds will be found gradually merging into the trades. But at all times a bright lookout should be kept for gales from SE. and SW., which are quite frequent in December. Cross the parallel of 25° N. at 23° W.; then 22° or 23° N. at 33° W.; after which steer due west, keeping below 23° N. The voyage should be ended as show in remarks Liverpool to New York, pp. 46–48.

Direct route.—A *steamer*, or an auxiliary steam vessel *which can make good time either under sail or steam*, may make a direct route from Gibraltar to New York. In January, February, and March the weather between the straits and the Azores will not be so very contrary, and then the probable calms may be crossed by the aid of steam. Stop at Fayal for coal; it may be obtained there for about $8 per ton.* From the Azores, lay a course for New York, following very nearly the arc of a great circle, and approaching toward the end of the voyage the points of crossing given in remarks Liverpool to New York, pp. 46–48. The same instructions apply to the other months of the year, with the following observations: In *April*, *May*, and *June*, on the passage to New York from the Azores, keep a lookout for icebergs, which frequently get down to 39° N. on the meridian of 45° W., and reach the parallels of 40° or

*Calling at Flores (Azores), very probably coal will not be found. Wood costs from $7 to $7.50 per ton.

45° N., from the meridian of 38° to that of 58° W. In *July*, *August*, and *September*, look out for cyclones (especially in July and August), in the western part of the Atlantic; icebergs will not, in all probability, be met with, unless the course leads to the northward of 41° 30′ or 42° N. between the meridians of 38° and 60° W. In *October*, *November*, and *December*, no fears need be entertained of encountering calms to the southward of the Azores, so the course may be laid to pass either above or below them; in either case the parallel of 40° N. should not be crossed before passing the meridian of 43° W., after which run down the longitude on that parallel.

Route from Europe to Newfoundland (from Brest or the Channel).—The course to be followed should be as nearly as possible the arc of a great circle, drawn between the point of departure and Cape Race, lying as far north as 50° or 51° N. On these parallels the degrees of longitude are much shorter, and the SW. winds will be found to be less persistent. And there are also more chances of encountering NW. winds, varying to the northward. The advantage of this route in high latitudes is shown by the passages of vessels from Scotland to Newfoundland, which, on an average, make much quicker trips than those from the Channel.

Small steamers, and all other vessels of poor sea-going qualities, will find it advantageous to call at Corunna and Fayal, which divides the route into three parts, and affords them two opportunities of taking in coal.

The difficulties of this route, as we have already said in relation to that between New York and the Channel, consist principally in the icebergs, fogs, cloudy weather, hazy horizon, irregular currents, rapid changes of variations, and cyclones. On this subject we advise the reader to refer to the remarks at the end of remarks from New York, English Channel and Liverpool, p. 43 and the beginning of the next p. 46.

Leaving Gibraltar.—When obliged to make a stop somewhere, take the route by way of the Azores. On the other hand, pass to the northward, so as to avoid the calms which exist, particularly to the southward of those islands.

In *January*, *February*, and *March*, when leaving the straits, endeavor to cross 37° N. at or about 13° W.; 40° N. at 19° or 20° W.; 45° 30′ N. at 25° or 26° W. From this latter position make a direct course, as near as the winds will permit, for the point of destination, keeping on the parallel of 46° or 47° N. On this route there is a risk of encountering floating ice, particularly about the meridian of 45° W.

In *April*, *May*, and *June*, take a course, as nearly as possible, according to the wind, to correspond with the following crossings: Parallels of 37° 30′ N. at 15° W.; 40° N. at 25° W.; 42° 30′ N. at 38° W.; 45° N. at 45° W., and from this last position steer for Saint Pierre. At this season of the year look out for icebergs, which get very far to the

southward, between the meridians of 58° and 36° W., and sometimes reach the parallel of 38° 30′ N., on the meridian of 45° W.

In *July*, *August*, and *September*: At this season there are 20 per cent. of chances of calms to the eastward of the straits, and 10 per cent. to the westward, as far as the meridian of 10° W. Consequently it is necessary, in sailing-vessels, to first make all possible westing without endeavoring to get to the northward, until after that meridian shall have been passed. Try to cross 38° N. at 15° W.; 40° N. at 19° or 20° W.; and then steer to cross the meridian of 25° W. at 44° or 45° north latitude, in order to avoid, as much as possible, the zone comprised between 40° and 45° N. and 25° to 30° W., where at least 10 per cent. of calms will be found. (This need not be taken into account in auxiliary steamers.) Then run on the parallel of about 45° N. to Saint Pierre, looking out for icebergs after passing the meridian of 38° W.; look out, also, for cyclones, especially in August and September.

In *October*, *November*, and *December* sailing-vessels may follow a very different route from steamers, passing to the southward of the Azores, where calms do not exist at this season of the year. They should then steer due west on the parallel of 37° 30′ N., making no northing until after passing 35° W. The winds are very favorable when leaving the Azores ; that is, they frequently blow from the SE. Theparallel of 38° N. may easily be crossed at 40° W., 40° N. at 46° W., and 43° N. at 50° W.

It is evident that good auxiliary steam vessels need not follow this route. It will be to their advantage to cross 40° N. at 18° W., 45° N. at 25° W., and to make their westing above the parallel of 45° N.

Route from Newfoundland to the Channel.—This passage is very rough in winter, on account of the many terrific gales and the heavy sea likely to be encountered, but, as a route to be followed, is exceedingly simple. The prevailing winds between Newfoundland and the Channel being from the westward, a course should be laid directly for the port of destination.

In *January*, *February*, and *March*: At this season, and especially during the last month, ice may be met with until after the meridian of 45° W. is reached.

In *April*, *May*, and *June* sailing-vessels will avoid a part of the calms and will make a better passage by crossing the parallel of 47° 30′ N. at 48° W., and that of 50° N. at 45° or 44° W. From this latter position all fear of ice may be laid aside, and a course made on the parallel of 50° N. to 35° W.; from which point the course may trend to the northward to reach 50° 30′ N. at 23° W.; cross 50° N., the second time, between 11° and 12° W., and 49° 25′ N. at 5° W.

In *July*, *August*, and *September* lay the course to cut 47° 30′ N. at 48° W.; 48° 45′ N. at 40° W.; 49° 25′ N. at 30° W.; and continue on this latter parallel, taking especial care not to get to the northward of 50° N., where about 15 per cent. of calms will be found when between the me-

ridians of 20° and 25° W. By following the route which we have just given, vessels will not be exposed to meeting icebergs, at least beyond 41° W.

In *October*, *November*, and *December* steer, with favorable winds, to cut 47° N. at 45° W.; 47° 30′ N. at 40° W.; 48° 45′ N. at 30° W.; follow this parallel of 48° 45′ N. to the meridian of 20° W.; then cross 49° N. at 15° W.; 49° 15′ N. at 12° W.; and 49° 25′ N. at 5° W.

Route from Newfoundland to Gibraltar.—In *January*, *February*, and *March*, after leaving Saint Pierre,a bright lookout for ice must be kept until after passing the intersection of the parallel of 45° 30′ N., and the meridian of 45° W. From this point, with generally favorable winds, a course should be steered to cross the meridian of 25° W., on the parallel of 42° N.; then cross 40° N. at 20° W., and the parallel of Trafalgar, where land shoud be made, at 12° W.

In *April*, *May*, and *June* winds generally favorable. Steer to cross 45° N. at 50° W.; 42° 30′ N. at 40° W.; 40° N. at 30° W.; 39° N. at 25° W.; 37° 30′ N. at 18° W.; and the parallel of the land-fall expected to be made (Trafalgar or Spartel) at 10° W. Ice may be met with between Saint Pierre and the meridian of 36° W.

In *July*, *August*, and *September* steer an east course, on 45° 30′ or 46° N. to 36 or 37° W., which is the limit of the icebergs at this season. Then cross 44° 30′ N. at 30° W.; 42° 30′ N. at 20° W.; 39° N. at 15° W.; and the parallel of the point where the land-fall is to be made (Trafalgar oftener than Spartel) at 10° W.

In *October*, *November*, and *December* steer due east, keeping to the northward of 45° N. until reaching the meridian of 28° or even 25° W. If 45° N. is crossed before 25° W. is reached, there will be great risk of being detained in zones containing 10 per cent. of chances of calms. Then steer to cross 42° 30′ N. at 21° W.; 40° N. at 16° W., and the parallel of Trafalgar (which should be the point of land-fall) at 10° or 9° W. longitude.

Route from the Channel or Gibraltar to the West Indies and Cayenne.—In order to gain the trades from the Channel or Gibraltar, follow the directions given, for each season of the year, when speaking of the *southern route* from Europe to New York. (See English Channel and Liverpool to New York, and Gibraltar and New York, pp. 46–48 and 53.)

In *January*, *February*, and *March:* At this season the best parallels on which to run down the longitude through the trades, when bound to the West Indies, are those comprised between 20° and 10° N. Vessels bound to Cayenne may make a direct course for that place, through the trades, with the wind well on the starboard quarter; in fact nearly astern.

In *April*, *May*, and *June:* From 25° N., which should have been reached at 23° or 25° west longitude, steer to cut 20° N. at 30° W.; and from this position, if bound to the West Indies, make a westerly course between the parallels of 15° and 20° N.; when bound to Guiana steer

from 20° or 30° W. directly for the port of destination. Frequent calms may be expected in the zone comprised between the meridians of 50° and 55° W. and the parallel of 10° N., and the coast of Guiana. In May and June there are rains and variable and squally winds on the coast.

In *July*, *August*, and *September* a course should first be steered to cross 25° N. at 25° or 26° W., and then to cross 20° N. at 35° or 36° W. From this latter position, or even a little before reaching it, the course may begin to trend toward the West Indies, making a due west course after having reached the parallel of the port of destination. When bound to Guiana steer directly for Cayenne from 20° N. and 35° W. In approaching Guiana, and when below 10° N., the winds will frequently haul to ESE., and there will then be 10 per cent. of chances of calms.

In *October*, *November*, and *December* cross 25° N. at 25° W.; 20° N. at 34° or 35° W.; and from this position a direct course for the port of destination should be steered; that is to say, trend to starboard when bound to the West Indies, and take almost the same course if going to Cayenne.

Route from the West Indies and Guiana to Gibraltar.—Considered in a general manner, this route consists in taking the starboard tack when leaving the West Indies or Cayenne, so as to leave the region of the trades, by making northing as quickly as possible, in order to reach the region of *general westerly winds*, which will be found more or less to the northward, according to the season. The remainder should be made in accordance with the indications, which we shall now proceed to give.

In *January*, *February*, and *March* the greatest exertions should be made to avoid getting into the zone comprised between the parallels of 25° and 30° N. and the meridians 55° and 65° W., where a large per cent. of calms is known to exist. For the same reason, the vicinity of the Bermudas should, if possible, be avoided. It is advantageous then, with a sailing-vessel, to cross 25° N. *to the westward* of the meridian of 64° or 65° W.; 30° N. at or about 68° W.; and, finally, 35° N. at 65° W., which should be very easy to accomplish with the winds, which, in that locality, are mostly from the westward; but, at the same time, great care should be taken to avoid getting to the eastward of the meridian of 65° W. before having passed to the northward of 35° N. From 35° N. and 65° W., a route approaching the arc of a great circle should be steered; crossing 37° 30′ N. at 58° W.; 39° 30′ N. at 50° W.; 41° N. at 35° W.; 39° 30′ N. (a second time) at 20° W.; and, from this latter position, to cross the parallel of Trafalgar (where land is usually made at this season) at 10° W.

This voyage may be shortened very much by an auxiliary steam vessel, which may use steam when encountering the calms of Cancer, in 26° or 27° north latitude. After this she should steer to cross 30° N.

to the eastward of 60° W., from which time the winds will be favorable, and a direct course may be made for the straits, crossing 32° 20′ N. at 40° W., and 35° N. at 20° W.; from that point she could easily run for the straits.

In *April*, *May*, and *June* sailing-vessels should avoid passing into the two zones of calms lying between the parallels of 25° and 30° N., the first being limited by the meridians of 45° and 50° W., and the second by those of 55° and 60° W. An auxiliary steam vessel need not take any notice of these two zones, where from 10 to 15 per cent. of calms are to be found. When leaving Guiana take the starboard tacks aboard and cross 10° N. at 55° W.; 20° N. at 59° or 60° W.; the winds then hauling aft, 25° N. may be crossed at the same meridian; then 30° N. at 57° or 58° W.; 35° N. at 50° W., and from there, with favorable winds, a course approaching the arc of a great circle should be steered, crossing, successively, 38° N. at 40° W.; 39° 30′ N. at 30° W.; 39° N. at 20° W., and 36° 30′ N. at 10° W.; from which place steer for the land (Trafalgar or Spartel), according to circumstances.

When leaving the Lesser Antilles, at this season of the year, a vessel will find herself so much farther to leeward that she will not be able to cross 20° N. to the eastward of 63° W., or 30° N. beyond 64° or 65° W.; the winds will then, as a general thing, haul aft, and permit her to cross 35° N. at 59° 10′ or 60° W.; 38° N. at 50° W.; and 40° N. at 40° W. She should make due east on this parallel of 40° N., and from there may steer to cross 39° N. at 20° W., and 36° 30′ N. at 10° W.

In *July*, *August*, and *September* sailing-vessels leaving Guiana or the Windward Islands should not hug the wind, but should adopt the course of passing to the westward of the Bermudas. By following this advice they will avoid fairly losing themselves in the zones of calms, which would be found to be exceedingly persistent, lying between 48° and 65° W., and 25° or 26° and 35° N. The lost time could then be made up in the region of westerly winds. So sailing-vessels should cross 30° N. *to the westward* of 65° W., 34° N. at about 67° W.; after which, the winds becoming favorable, they should steer in the following manner: to cross 37° 30′ N. at 56° W.; 38° 45′ N. at 50° W.; 40° N. at 40° W.; run east on this latter parallel to the meridian of 26° 10′ W., and then cross 39° N. at 20° W., and the parallel of the land-fall point (Trafalgar oftener than Spartel) at 10° W.

This route will also be used by small steam dispatch-boats which sail very poorly; they may touch at the West Indies when coming from Guiana, and take in coal again at the Azores. Auxiliary steam vessels with good sailing power should hug the wind and make a fair course on the starboard tack until the zone of calms or light breezes, about 26° or 27° N., is reached. Then under steam they may make for the position 30° 30′ N. and 54° 10′ W. At this point, or even a little before reaching it, the winds will be found favorable, and they can easily,

under sail, cross 35° N. at 43° W.; 37° N. at 30° W.; and from that point may make a course for the straits. They will be able to call at the Azores by putting a little more northing in their course, without detaining them any time at all.

In *October*, *November*, and *December:* This is the most favorable of all the seasons, as more westerly winds are encountered than any others. A good sailer, leaving Guiana on the starboard tack, may succeed in crossing 20° and 25° N. at 56° 10′ W.; 30° N. at 55° W.; 35° N. at 49° 10′ W.; 36° 30′ N. at 40° W., and from this point may easily steer for the straits with generally favorable winds. No calms will be encountered to the southward of the Azores, and vessels should make the land at Trafalgar.

Sailing from the West Indies, cross 20° N. at about 63° W.; 25° N. at 63° 10′ W.; then, the winds becoming favorable, 30° N. can generally be crossed between 60° and 62° W., and 35° N. at 50° W.; from this latter position continue the course as when starting from Guiana.

Vessels sailing from the West Indies should guard against falling into the zones comprised between, first, 25° and 30° N., and 65° and 70° W.; second, 30° and 35° N., and 60° and 65° W. In these two zones there are 10 per cent. of chances of calms. Sailing-vessels leaving Guiana should avoid the zone comprised between 25° and 30° N., and 50° and 55° W., where there are 12 per cent. of chances of calms.

Auxiliary steam vessels cannot shorten this route without expending large quantities of coal; they may call at the Azores if necessary.

Route from the West Indies and Guiana to the English Channel.—The first part of this route is the same as that given in the preceding paragraph. Consequently we shall only examine, for each season of the year, what would be the best route from the Azores to the Channel. This will not apply to small steamers which sail very poorly, and are absolutely obliged to stop on the way for coal. In their case it is necessary to go by way of the Azores, and the route is thereby considerably lengthened.

In *January*, *February*, and *March* sailing-vessels, after having arrived at the intersection of 35° N. with 65° W., as directed in the preceding paragraph, should steer to cross: 40° N. at 55° W.; 45 N. at 40° W.; and 47° 30′ at 30° W.; 49° N. at 25° W.; and 49° 30′ N. at 10° W. On this voyage a sharp lookout should be kept for icebergs, particularly in March, as they may be met with to the northward of 42° N. when between the meridians of 45° and 55° W.

In *April*, *May*, and *June:* At this season it will be best for sailing-vessels to avoid the area of calms (10 to 15 per cent.) lying between the parallels 25° and 30° N., and the meridians of 45° and 50° W., and of 55° and 60° W. The voyage should be commenced as pointed out in the last paragraph.

In *leaving Guiana* the starboard tacks should be brought aboard, and a course made to cross 30° N. at 57° or 58° W.; from there, with

generally favorable winds, a course should be steered to cross 35° N. at 52° 10′ W.; 40° N. at 45° W.; 45° N. at 35° W.; 47° 30′ N. at 25° W.; 49° 25′ N. at 10° W.; and from the latter position the course should be along the parallel of 49° 25′ N. to enter the Channel.

When sailing from the Lesser Antilles the route is almost the same. After having crossed 30° N. at 64° or 65° W., a course should be made to cut 35° N. at 60° W.; 40° N. at 50° W.; 45° N. at 38° W.; 48° N. at 25° W.; 48° 30′ N. at 20° W.; 49° N. at 15° W.; and 49° 25′ N. at 10° W. At this season a watch should be kept for icebergs, as they often get as far south as 39° N. between 38° and 58° W.

In *July*, *August*, and *September* a course should be steered as directed in West Indies and Guiana to Gibraltar, p. 58, in such a manner as to cross 30° N., to the westward of 58° W.; 34° N. at about 67° W.; and from there, with winds generally favorable, to cross 37° 30, N. at 63° W.; 40° N. at 58° W.; 41° 30′ N. at 55° W. (where ice may be expected); 45° N. at 45° W.; 46° 25′ N. at 40° W. (when all danger of encountering ice ceases); 48° N. at 30° W.; 49° 25′ N. at 20° W.; 49° 30′ N. at 15° W.; and 49° 25′ N., the second time, at 10° W.; and from there make for the Channel.

In *October*, *November*, and *December:* This season, as was said in West Indies and Guiana to Gibraltar, p. 58, is very favorable, the limit of the trades being then the farthest south.

Leaving Guiana on the starboard tack, 20° and 25° N. can be crossed at 56° 10′ W.; 30° N. at 55° W.; 35° N. at 50° W.; 40° N. at 40° 10′ W.; 45° N. at 29° 10′ W.; 47° 30′ N. at 20° W.; 48° 15′ N. at 10° W.; and 49° 25′ N. at 5° W.

Leaving the *Lesser Antilles*, vessels will be more to leeward, and cannot cross 25° N. to the eastward of 63° 10′ W. From this position the winds generally veer favorably, and an effort may be made to cross 30° N. between 60° and 62° W.; then cross 35° N. at 55° W.; 40° N. at 47° 10′ W.; 45° N. at 35° W.; 47° 30′ N. at 20° W.; 48° 45′ N. at 10° W.; and 49° 25′ N. at 5° W.

We shall repeat the advice given in West Indies and Guiana to Gibraltar, p. 58, viz, avoid the zones where calms are to be found; these lie, first, between the parallels of 25° and 30° N., and the meridians of 65° and 70° W.; second, between the parallels of 30° and 35° N., and meridians of 60° and 65° W., where 10 per cent. of calms exist; and third, between parallels 25° and 30° N. and 50° and 55° W., where there are 12 per cent. of calms.

Route from the Channel or Gibraltar to Senegal.—The first part of this passage should be made as pointed out, for each season, when bound from the Channel or Gibraltar to the trades. (See southern route from the Channel or Gibraltar to New York, pp. 46–48.)

When leaving the Channel, vessels should pass to the westward of Madeira, and their position may be verified by a sight of Palmas or

Hierro Island. Leaving Gibraltar they may pass between Madeira and the Canaries, and Teneriffe may be sighted.

Leaving Teneriffe, the course should be S. by W. ½ W., true, until the parallel of 21° N. is reached; then steer south to the parallel of 20° N., and from there, SE. ¼ S. The first course leads about 25 leagues off shore of the coast; the second, 26 leagues to the westward of the Arguin Bank, and the third strikes the coast toward the Maringonius Pool.

It is never necessary to sight the African coast in order to run it down, when bound to Senegal or Gorée, and, when looking for the anchorage off the bar, it is useless to made a land-fall more than 15 or 20 leagues above Senegal.

To the northward of Senegal, 61.8 fathoms water, bottom of white sand, will be found about 10 leagues off shore; this depth diminishes gradually, so that at 1 mile off shore there is but from 6 to 7 fathoms water. At night vessels should anchor as soon as 15 fathoms water is reached, and should await daylight to coast the shore, so they may avoid striking on the bar.

To reach Gorée from Senegal, make a run of 31 leagues, S. 40° W., follow around Cape de Verde, and the island of Gorée will be found in full sight.

Route from Senegal to Gibraltar.—In *January*, *February*, and *March* sailing-vessels leaving Senegal should take advantage of every favorable change in the wind (NNW. to NNE.) to make all the northing possible on the starboard tack, so as to cross 17° 30′ N. at 20° W. From this meridian the winds will prevail from NNE., and the parallel of 20° N. may easily be crossed at 25° W.; the winds will then have a tendency to the ENE., and 25° N. may be crossed at 27° W., or farther to the eastward, if possible; they will then become variable, and will blow, in all probability, as frequently from the westward as from the eastward, and vessels may hope to make a true north course after passing 25° north latitude, or even a little to the eastward of that, so as to be able to cross 30° N. very near the meridian of 25° W. Then continue steering for the straits as often as the winds will permit, passing to the westward of Madeira, and avoiding the zone of calms limited by the parallels 35° and 40° N. and the meridians 25° and 35° W. Cross 35° N. between 15° and 23° W., according as the winds are more or less favorable, and run an east course on the parallel 35° 30′ or 36° N., making the land, generally, at Cape Trafalgar.

In this same season sailing-vessels, badly handled, or making but poor way "on a wind," may often find themselves so far to leeward as to be forced to pass to the westward of the Azores. In this case it would be necessary to cross 35° N. *to the westward* of 31° W., and 40° N. *to the westward* of 30° W., in order to avoid falling into the very persistent calms about the locality of those islands. Then continue as directed in the paragraph on the route from New York to Gibraltar.

This latter advice will apply to small steamers of poor sailing and steaming qualities. They should reserve their coal for the calms of the Azores, and replenish their supply at Fayal.

Good auxiliary steam vessels, sailing well, and able to steam moderately, will find it advantageous to get up steam, after having reached 30° N. and 26° or 25° W., *under sail.* From there they may steer for Madeira, provided they wish to call there, making use of sail when the wind favors them, andhauling fires after reaching 35° N., which should be crossed at 25° or 26° W. Then an east course should be made, *under sail*, on the parallel of 35° 30′ or 36° N., sighting the land, as a general thing, at Cape Trafalgar.

In *April*, *May*, and *June* the voyage is much more difficult at this than during the preceding season, as the trade-winds reach farther north. Leaving Senegal, cross 17° 30′ N. at 20° W.; 20° N. at 23° 10′ or 24° W.; 25° N. at 28° W.; and 30° N. at 30° W. Avoid as much as possible the zone of calms lying between the parallels 25° and 30° N., and the meridians 30° and 35° W., where 10 per cent. of calms are known to exist; and also the zone between the meridians 25° and 30° W., and extending from the parallel of 30° N. to the Azores; on this latter there are 15 per cent. of calms. After having crossed 30° N. at 30° W., the winds will haul, and a course may be steered to cross 35° N. at 25° W., from which place a course may be made for the straits.

This route cannot be shortened, even in auxiliary steam vessels, except by a very great expenditure of coal.

Poor sailers and small steam dispatch-boats will find themselves far to leeward, and the sailing-vessel may be obliged to pass around to the westward and northward of the Azores, as in the preceding season. The steamers may take in coal at Fayal ($7.90 or $8.10 per ton). The remainder of the route may easily be accomplished.

In *July*, *August*, and *September:* During this, as in the preceding season, vessels will be obliged to run well to the northward in order to get clear of the trade-winds. Sailing-vessels will have to pass to the westward of the Azores by crossing 20° N. at about 22° W.; 30° N. at 29° 10′ W.; 35° N. at 31° W.; 39° N. at 30° W.; and from the last position, with winds generally favorable, may touch 40° N. at 25° W., and run along to cross 39° 15′ N. at 20° W.; 37° 30′ N. at or about 13° W.; and the parallel of the land-fall, that is to be (Trafalgar oftener than Spartel) at 10° W.

A weatherly auxiliary steamer may shorten this passage considerably, by keeping a good rap full, without trying to jam up on the wind. She may expect to cross 30° N. at 28° W., and 35° N. at 28° 10′ W., at the outside; and then, with the aid of her engines, may run to where the winds will be found in her favor, viz, 35° 30′ or 36° N., and 25° or 24° W.; from the latter position the straits may easily be reached.

Small steamers with poor sailing qualities should try to follow the first course pointed out for sailing-vessels; they have the advantage,

however, after reaching 35° N., of generally favorable winds, which will enable them to call at the Azores to recoal, and then stand in for the straits.

In *October*, *November*, and *December*: The trades not extending so far to the northward, this season is much more favorable for the passage; but vessels are liable to be delayed by the calms (12 per cent.) to which they will be exposed between the parallels of 25° and 30° N., and the meridians 25° and 35° W.; 15 per cent. of calms will be found between 30° and 35° N. and 20° and 30° W. Between these same parallels of 30° and 35° N., but from the African coast to 10° W., there are but 10 per cent. of calms.

Leaving Senegal, a good sailing-vessel should take the starboard tack to cross 20° N. at 20.° W.; 25° N. at 25° W.; 30° N. at the same meridian of 25° W.; and 35° N. at or about 24° W., from which position an easterly course may easily be made with generally favorable winds by running on the parallel of 36° or 36° 30′ N.

When set far to leeward through unusual and contrary winds or poor sailing qualities, it will be advantageous to stand a little free, even with studding-sails set, in order to cross 25° N. at 30° W. The winds will be found much more favorable there, and a northerly course may be made on the meridian of 31° 10′ W., as high as 35° N.; then by steering to cross 36° N. at 25° W., from which place the winds will be fair for the straits.

An auxiliary steamer should first follow the course we have just given until clear of the trades, then make a northerly course under steam through the calm region until she meets with well-established winds, and those will generally be from the westward.

Route from Senegal to the Channel.—In *January*, *February*, and *March* sailing-vessels should keep a good full on the starboard tack when leaving Senegal. They will cross 18° N. at 20° W.; 20° N. at 24° or 25° W.; 25° N. at 28° or 29° W.; 30° N. at 31° W.; 35° N. at 32° W.; 40° N. at 31° W.; 45° N. at 25° W.; 47° 30′ N. at 20° W.; 49° 30′ N. at 10° W., and from there steer for the Channel.

At the same season, small auxiliary steam vessels of poor steaming and moderate sailing qualities should make for the Azores on the course laid down in the preceding paragraph. After recoaling at Fayal, they should steer to cross 40° N. at 45° W.; 43° N. at 20° W.; 45° N. at 18° W.; 47° 30′ N. at 10° W.; 49° 25′ N. at 5° W., and from there may run for the Channel.

A good auxiliary steam vessel, with fine sailing qualities, may run under sail, as pointed out in the preceding paragraph, to 30° N., which should be crossed at 25° or 26° W. From there she may steer, making use of steam when necessary, to cross 35° N. at 25° W.; and from this point she may, under sail, run to cross 40° N. at 20° W.; 45° N. at 14° 10′ W.; and 49° 25′ N. at 5° W.

In *April*, *May*, and *June* a good full should be kept in order to make a course that will always cross the parallel of 30° N. as far to the eastward, at least, as 30° or 31° W. Then steering to cross 35° N. at 30° W.; 40° N. at 30° W.; 45° N. at 25° W.; 47° 30′ N. at 20° W.; and 49° 30′ N. at 10° W., and from there making a course to the Channel.

Small auxiliary steamers, after having reached 35° N. at 33° or 35° W., should make for the Azores, where they may recoal.

In *July*, *August*, and *September* sailing-ships should pass to the westward of the Azores and make a course rap full on the starboard tack. They should cross, successively, 20° N. at or about 22° W.; 30° N. at 29° 10′ W.; 35° N. at 31° W.; 40° N. at 31° 10′ W.; 44° 30′ N. at 30° W.; 47° 30′ N. at or about 21° 10′ W., and 49° 25′ N. at 10° W.

Small steamers poorly masted should leave the trades at or about 30° N., and 30° or 33° W.; then make to the northward on 35° or 36° W., and from there, with favorable winds, should steer for a call at the Azores.

When leaving the Azores, a route will be easily followed to cut 40° N. at 25° W.; 43° 30′ N. at 20° W.; 45° N. at 16° W.; 48° N. at 10° W., and 49° 25′ N. at 5° W.

In *October*, *November*, and *December*: For the first part of the course we refer to the advice given in paragraph Senegal to Gibraltar, p. 62, for the same season.

An auxiliary steam vessel with good sailing qualities may, with a moderate expenditure of coal, make a good passage by crossing under sail the parallel 20° N. at 20° W.; 25° N. and 30° N. at 25° W.; and then, lighting the fires, if necessary, cross 35° N. at 24° W. From this point the winds will be favorable, and she may easily cross 40° N. at 20° W.; 45° N. at 15° W.; 47° 30′ N. at or about 12° 10′ W., and 49° 25′ N. at 5° W.

It will be advantageous for sailing-vessels to keep a good full, when in the trades, without trying to cross 25° N. before reaching 29° or 30′ W.; from there they may run to cross 30° N. at 31° 30′ or 32° W., where favorable winds will be found, and with them they may cross 35° N. at or about 31° 30′ W.; then 40° N. at 25° W. (no fear of calms near the Azores); 45° N. at 20° W.; 47° 30′ N. at 13° W., and 49° 25′ N. at 5° W.

This latter route is also good for small poorly masted steamers, which may, by following it, call at the Azores for a supply of coal.

Route from France to the Gaboon River.—Leaving the Channel or Gibraltar, vessels should follow the routes laid down in English Channel and Liverpool to New York, p. 41, and Gibraltar to New York, p. 53, to reach the trades. Vessels from the Channel should pass to the westward of Madeira, where they may verify their positions by sighting the island of Palmas or that of Hierro. Those from Gibraltar should pass between Madeira and the Canaries, and may sight Tene-

riffe. If it is desired to run through the Canary Archipelago, the channel between Palmas and Hierro on the west, and Gomera on the east, should be chosen.

Follow the African coast at a short distance off shore, and sight Cape de Verde. From Cape de Verde to Cape Palmas the winds are favorable from October to May, and contrary from May to September; at this latter season, vessels should keep a hundred leagues off shore. Pass in view, or 20 leagues off shore, of Cape Palmas; then keep in the northern part of the favorable Guinea current, between the coast and the parallel of 2° or 3° N. This is the only general advice that can be given to make the passage from France to the Gaboon. We shall, however, give the principal points for crossing different parallels and meridians, and the distinguishing circumstances of this route for each season of the year.

In *January*, *February*, and *March*, cross 20° N. at 19° W.; 15° N. at 19° W.; 10° N. at 17° W.; then enter a zone containing 18 per cent. of calms; stand on to cross 7° 30′ N. at 15° W.; from this point 22 per cent. of calms will begin to be experienced, which last until 5° N. is crossed at 15° W.; then there are but 9 per cent. until 4° N. is crossed at 10° W.; after which the route is continued with favorable winds, and with but from 4 to 6 per cent. of chances of calms.

In *April*, *May*, and *June*, after having crossed 20° N. at 20° W., and 15° N. at the same meridian, sailing-vessels should steer to cross 10° N. at or about 21° W., having the winds favorable from NE. From this latter position a zone containing 17 to 18 per cent. of calms is entered, and vessels should head SE. to cross 5° N. at 16° W., and 4° N. at or about 15° W. Continuing from this position, they steer E. or E. ¼ N., the winds being southerly and consequently favorable; finally, there will only be 8 per cent. of calms. Cross the parallel of 3° N. at 5° W.; and steer, with the southerly winds, on a course between the coast and the parallel of 2° or 3° N. Between the meridian of Greenwich and 5° W. there are 11 per cent. of calms; between the meridian of Greenwich and 5° E. no calms, and to the eastward of 5° E. there are 14 per cent. of calms.

Auxiliary steamers need not make so great a detour as the one we have described. They may run along the coast about 60 leagues off shore, between Cape de Verde and Cape Palmas; only they will find the winds more ahead, and about 16 or 18 per cent. of calms from the parallel of 15° N.; if they cross it to the eastward of 20° W. (See Zones of Calms, &c., p. 11.)

In *July*, *August*, and *September* the parallel of 20° N. should be crossed at 20° 10′ W., and 15° N. at 21° W. From this parallel there are 10 per cent. of calms, with the winds variable, but predominating from NE., and with them it will be easy to cross 10° N. at or about 22° W. Beyond 10° N. there are but 8 per cent. of calms, and the monsoon will be found well established from S. to SW. The parallel of 7° 30′ N. may

generally be crossed at 20° W., which will be a very fine position from which to make a run with well-established southerly winds, to cross 5° N. at 15° W., and the parallel of 3° N. at 10° W. Crossing to the eastward of this meridian, SSE. or SSW. winds will be found, but more from SSW., which, when moving to the eastward, will become more and more settled at that direction. With these winds the course may easily be made without any fear of calms.

In *October*, *November*, and *December*, after having crossed 20° N. at 20° 10′ W., and 15° N. at 19° 10′ W., vessels will commence encountering about 8 per cent. of calms, with winds from NNE. to ENE., by the aid of which they may cross 10° N. at 17° W.

Beyond this parallel there are 28 per cent. of calms, with winds from SSW., NNE., and ESE., aided by which a course may be made to cross 5° N. at 15° W. If the meridian of 15° W. is passed before crossing 5° N., 35 per cent. of calms will be encountered. Having arrived at the intersection of 5° N. and 15° W., an ESE. course should be made on the starboard tack, with southerly winds, and but 8 or 9 per cent. of calms; after having crossed 3° 30′ N. at 10° W., the course should be continued to the eastward, with a mean of 10 per cent. of calms, and winds prevailing from SSE., SSW., SW., and even WSW., in proportion as the gulf is entered.

Route from the Gaboon to France.—At all times and from whatever part of the Gulf of Guinea vessels may start, the most direct route, as a general rule, is to steer to the southward as far as the equator; then to run to the westward on a parallel close to it, on the equator itself or even to the northward of it, from May to December, and from 0° 30′ S. to 1° S. in the other half of the year. No northing should be put in the course before arriving at a convenient longitude, which varies, according to the seasons, from 12° to 23° W.*

In *January*, *February*, and *March:* At this season, when the calms extend nearest to the equator, the longitude should be run down on 1° or 1° 30′ S.; cross the line at 21° 10′ or 23° W., and make a course to the northward, so as to leave the zone commencing at the equator and reaching to the parallel 5° N., and containing 21 per cent. of calms, as quickly as possible. An auxiliary steam vessel will derive every advantage from crossing this zone under steam. After leaving it, when the vessel shall have crossed 5° N. at about 21° 10′ W., she will find the trades from NE., with which she will stand on, on the starboard tack, to cross 10° N. at 25° W.; 15° N. at 26° 10′ W. (west of the Cape

* The routes given here for running from the equator to France lead vessels through longitudes much more easterly than those indicated farther on for making this passage. (See From the Equator to France, p. 78.) The western route will be the better one for vessels bound to the Channel, which cannot make good headway when close hauled through the trades. The eastern route will be preferred by good sailers, and those bound to Gibraltar. A choice should be made between the two, but on no account should an intermediate course be tried, as it will prove a very bad one.

de Verde Islands); 20° N. at 28° 15′ or 29° W.; and 25° N. at 31° W., where the trades will be lost.

Arrived at 25° N. and 31° W., if *bound to Gibraltar*, a course should be made, with the variable winds, to cross 29° N. at 30° W.; 32° 30′ N. at 25° W.; 35° N. at 20° W.; 35° 30′ N. at 15° W.; and from there to the point selected as a land-fall. (Generally Trafalgar.)

From 25° N. and 31° W., when bound to the *Channel*, steer, with the variable winds, to cross 30° N. at 31° 10′ W., where winds will be found blowing from the southward, with which a good run may be made to cross 35° N. at 31° 10′ W., and 39° N. at 30° W.; then, with the variable winds, steer to cross 42° 30′ N. at 26° W.; 45° N. at 21° 10′ W.; 47° 30′ N. at 16° W.; and the winds will then be found prevailing from the westward, but there will be from 8 to 10 per cent. of calms up to the Channel. It will be advantageous to cross 49° N; at 10° W., and to reach 49° 25′ N. (parallel of mouth of Channel) at 5° W.

In *April*, *May*, and *June* the westerly course should be made either on the equator or a few miles below it, at about 0° 30′ S., putting a little northing in it after reaching the meridian of 10° W.; cross the line at 10° 10′ W., steering, with generally favorable winds and 8 per cent. of calms, to cross 5° N. at 15° W., and from there, with winds still favorable, but with 18 per cent. of calms, run to cross 10° N. at 20 W. Leaving 10° N., the trades will be encountered well ahead at first, so that vessels cannot lay higher than NW. A call may be made at the Cape de Verde Islands, if desired, but if not, 15° N. should be crossed at about 25° W.

From this point the trades will begin to vary from NNE. to ENE., which will generally allow 20° N. to be crossed at 27° W., and 27° 30′ N. at 30° W., this latter point being the limit of the trades.

At this latter point, when bound to the *Straits of Gibraltar*, an auxiliary steam vessel should get up steam and steer NE. in order to reach 35° N., between the meridians of 21° and 24° W.; then, under sail and with favorable winds, run along near 35° N., for the point selected as a land-fall (either Trafalgar or Spartel). Sailing-vessels, finding themselves on 27° 30′ N. and about 30° W., should steer about NNW., with variable winds and 8 per cent. of calms. Then crossing 30° N. at 31° W., where more favorable winds will be found interspersed with but 2 to 3 per cent. of calms; and steering due N. from this latter point on the meridian 31° 10′ W. until 34° N. is reached, after which easting should be put in the course so as to cut 34° 30′ N. at 30° W., making every exertion to cross the zone of calms (8 to 9 per cent. of calms) by steering to cross 35° 30′ N. at 25° W. From there, if not absolutely necessary to make easting below 36° N., the winds will generally be found favorable up to the straits.

Vessels *bound to the Channel*, leaving 27° 30′ N. and 30° W., should steer with variable winds and 8 per cent. of calms, so as to cut 30° N. at 31° W.; the winds will then become more favorable, and they can

steer due N. on the meridian of 31° 10′ W. No easting should be put in the course until after passing 39° N.; then cross 40° N. at 30° W.; 45° N. at 25° W.; 47° 30′ N. at 20° W.; 48° 30′ N. at 15° W.; and 49° 15′ N. at 10° W.; after which keep on to enter the Channel. An auxiliary-steam vessel will do well to follow the same route, which may be modified by calling at the Azores.

In *July*, *August*, and *September*, westing should be made on 1° or 1° 30′ N. with winds from SSW. to SSE., and commencing to make northing at 10° or 9° W. Then standing on, with southerly winds, 5° N. may be crossed at 15° W., and 10° N. at 17° W. From this latter position the winds will be found to be variable from SSW. to NW., but an effort should be made to cross 15° N. at 20° W. If forced to the westward of 20° W., before having crossed 15° N., at least 11 per cent. of calms may be expected; while by leaving 15° N. at 20° W., the winds will be found from NE. ¼ N., but interrupted by breezes from E., and with them vessels should lay as high as possible on the starboard tack to cross, successively, 20° N. at 23° W.; 25° N. at 26° W., and 30° N. at 29° W., which last parallel is the limit of the trades.

Arrived at 30° N. and 29° W., *when bound to the Straits of Gibraltar*, sailing-vessels should, with winds first from NNE. to ENE., then hauling to SE. and SSW., steer to cross 35° N. at 31° W., and 39° N. at 30° W., and from there, with generally favorable winds, make a course tangent to 40° N. at 25° W.; then cross 39° 15′ N. at 20° W.; 37° 30′ N. at or about 13° W., and the parallel of the land-fall (Trafalgar oftener than Spartel) at 10° W.

Auxiliary steam vessels may shorten this route a great deal without expending very much coal. Leaving 30° N. and 29° W., they should steer, making use of steam when necessary to reach favorable winds, at 35° 30′ or 36° N. and 25° or 24° W. From this position they may easily reach the straits.

Small steamers with poor sailing qualities will be obliged to follow a route similar to the one laid down for sailing-vessels, and, when near the Azores, may run in there for coal. From this place they can easily reach the straits.

Sailing-vessels, when *bound to the Channel*, after reaching 30° N. at 29° W., should first steer, as was pointed out for those bound to Gibraltar, to cross 35° N. at 31° W.; then with SSW. to WSW. winds, which will surely be encountered, they may make a good course to cross 40° N. at 31° 10′ W.; 44° 30′ N. at 30° W.; 47° 30′ N. at about 21° 10′ W., and 49° 25′ N. at 10° W.

Auxiliary steamers bound to the Channel may call, as was said before, at the Azores; and from that place they may, with generally favorable winds, run for the Channel; crossing, successively, 40° N. at 25° W.; 43° 30′ N. at 20° W.; 45° N. at 16° W.; 48° N. at 10° W., and 49° 25′ N. at 5° W.

In *October*, *November*, and *December*, westing should be made below the line, say on 1° S. The winds will be variable from S., SSW., and SW., up to the meridian of 5° W., then south winds between 5° and 10° W.; then SE. trades, beyond 10° W. Commence to put northing in the course at about 20° W., in such a manner as to cross the line near 22° W. From the equator to 2° 30′ N., which should be crossed at 25° W., the winds will be from S. and SE., with 14 per cent. of calms. Continue to the NNW. until the NE. trades are found. By being careful to keep to the westward of 25° W. the winds will be found more favorable; at first they will be from SE., varying to S. or E., with 10 per cent. of calms; and this will continue as high as 5° N., which should be crossed, if possible, at 27° W. Then steer due N., with easterly winds, varying from S. to SE., and NE., with 17 per cent. of calms. The NE. trades will be found at 10° N. and 27° W. in Octber; 7° N. and 27° W. in November; and 5° N. and 27° W. in December. These trades, called NE., really blow from E. 70 per cent. of the time as far as the parallel of 15° N., which should be crossed at 27° W.; above 15° N. the trades haul to ENE. and NNE., so that the course will be N. by W.; cross 20° N. at 28° or 28° 30′ W.; the winds will then be variable from ESE. to NNE., and 25° N. may be crossed at 30° W., and 26° or 27° N. at 31° or 31° 30′ W., where the trades will be lost, and variable winds from SSW., SSE., SE., and ENE., with 10 per cent. of calms, will be encountered. A good due north course may then be made on the meridian of 31° 10′ W., to the parallel of 30° N., at which place calms end, and the wind prevails from S., with occasional ENE., ESE., WNW., and WSW. breezes.

Arrived at 30° N. and 31° 10′ W., vessels bound to the *Straits of Gibraltar* should steer to cross 34° N. at 31° W., and 36° N. at 25° W., from which place the straits may easily be reached with generally favorable winds. Make the land at Trafalgar. Auxiliary steamers may shorten this passage by steaming through the equatorial calms; they may also, by the expenditure of rather a large amount of coal, steer NE. after having lost the trades, under either sail or steam as may be necessary, from the intersection of 26° N. and 30° W., to 36° N. and 19° W. They may then continue, under sail, with favorable winds, for the straits.

Having arrived at 30° N. and 31° 10′ W., vessels *bound to the Channel* should steer, with favorable winds, to cross 35° N. at 31° 10′ W., and 40° N. at 25° W., passing the Azores without fear of calms in this season. Then cross 45° N. at 20° W.; 47° 30′ N. at 13° W., and 49° 25′ N. at 5° W. An auxiliary steam vessel may shorten this route by the use of steam in the equatorial calm-belts. A call may be made at the Azores without sensibly lengthening the voyage.

CHAPTER III.

INSTRUCTIONS REGARDING THE PRINCIPAL ROUTES OF THE NORTH ATLANTIC OCEAN—Continued.

Route from France to the equator.—This route has been studied by the Utrecht Observatory, and will be found in the instructions translated and published by Lieutenant Le Helloco. We shall draw from this source, present a résumé of the recommendations given, and point out the best route to be followed from the Channel or Gibraltar, when bound to the equator. It is true that the route as given in these instructions applies to vessels bound to Java; but no matter what the destination of vessels after crossing the equator, the course to that circle being about the same, these Dutch instructions to the line are certainly the best that can be given for vessels bound to the southern hemisphere.

All that we say on this subject applies to vessels under sail alone. Auxiliary steam vessels may always follow the same course, steaming across the calm-belts separating the NE. and SE. trades just above the line.

In *January*, when leaving the Channel, vessels should not be so very anxious to make southing, but may cross 45° N. at 12° W.; then 40° N. at 15° W., keeping on, but being careful not to cross the meridian of 18° W. before having passed to the westward of Madeira. Then endeavoring to cross 35° N. at 18° W., and 30° N. at 19° 10′ W.; at this point the barometer will be noticed to rise, and the trades will be entered, and with them a course may be made to cross 25° N. at 20° W., and 20° N. at 25° W.; passing to the westward of Cape de Verde Islands, and crossing 15° N. at 26° or 27° W. From this position a south course should be made to cross 5° N. to the westward of 25° 10′ W. About 16 per cent. of calms will be experienced between 5° N. and the line; the course should be due south in this zone. In a short time, light "cat's-paws" from the southward will be felt; these are the forerunners of the SE. trades, and with them the port tack should be taken so as to avoid making anything to the eastward. When the SE. trades become well established, generally near the parallel of 1° N., a course as near south as possible should be made. The quickest passages will be made by vessels which cross the equator at 26° W. In case they are forced to cross at 30° W., no fear need be felt, for a good sailing-vessel may easily weather Cape Saint Roque.

In *January*, *February*, and *March*, vessels leaving Gibraltar will be exposed, when off the mouth of the straits, to heavy gales from south, hauling to W. and NW., and succeeding each other at short intervals; the heaviest squalls come from SW. The barometer should be carefully watched.

Pass between Madeira and the Canaries, and cross 30° N. at 19° W.; then 25° N. at 20° W., continuing as pointed out for vessels leaving the Channel.

If a call is made at the Canaries, a bright lookout should be kept for gales from SE. or SW.

In *February*, leaving the Channel, it is generally necessary to work against southwesterly winds; and vessels should endeavor to cross 45° N. as far as possible to the westward of 13° W.—at 15° W. if they can do so. It will then be necessary to cross 40° N. at 15° W., in order to avoid the very unfavorable zone lying between the parallels of 40° and 45° N., and the meridians of 10° and 15° W.; cross 35° N. near 18° W., passing to the westward of Madeira; 30° N. at 20° W., and continuing directly south to find the trades, by the help of which 25° N. may be crossed at 21° W., and 20° N. at 25° W. Pass to the westward of Cape de Verde Islands, and cross 15° N. at about 26° 10′ W. From this point make a good southerly course so as to cross 5° N. a little to the westward of 25° W. About 16 per cent. of calms will be met with between 5° N. and the line; the course through this zone should be south. In February and March the NE. trades are lost near the parallel of 1° N., and beyond this latitude light southerly breezes, which are always the forerunners of the SE. trades, will be felt. The port tack should be taken with the light airs, so as to avoid making any easting. When the SE. trades are well established, which at this season may even be at the line itself, as much southing as possible should be made. The best point for crossing the line will be at 26° W. No fears need be entertained, if forced to cross at 30° W., as a good vessel may easily double Cape Saint Roque from that position.

Vessels leaving Gibraltar should follow the same route, striking it as recommended for the preceding month.

In *March*, vessels leaving the Channel should make every endeavor to get to the westward, so as to cross 45° N. between the meridians of 12° and 13° W. From this point they may begin to make southing, trying to cross 35° N. at 17° W., and 30° N. at 20° W. This route passes to the eastward of Madeira, and leads through the zone limited by the parallels 35° and 30° N. and meridians 15° and 20° W., which is the most favorable position for catching the NE. trades. When they become well established a good course should be made to cross 18° 30′ N. at 25° W., and 5° N. at 26° W. From 5° N. to the equator there will be only 16 per cent. of calms, provided vessels remain to the westward of 25° W. Consequently they should rather bear off to starboard than to port. Steering this way the NE. trades will be lost near 3° N. and

26° W., and without any very great loss of time the SE. trades will be a little above the line, and about 26° W., and with them the port tack should be taken. Finally, the equator should be crossed near 26° 30′ W.

Vessels sailing from Gibraltar should follow the directions given for the month of January, until they gain the route we have just pointed out.

We will add that, in addition to what has been said in regard to the winds about Madeira and the Canaries (warning against SE. gales), in this month vessels are exposed to heavey NW. gales while lying at Madeira.

In *April*, when leaving the Channel, a course should be made to cross 45° N. between 10° and 11° W.; 40° N. between 14° and 15° W.; 35° N. at 18° W. at least, and, if possible, at 19° W. Then with the trades steer to cross 30° N. at 20° W.; 20° N. at 25° W.; and 10° N. at 28° W., or, at least, 27° W. After having passed the parallel of 10° N., about 8 per cent. of calms will be met with, until 5° N. is reached, and the trades will be variable and interrupted by light cat's-paws. Southing should be made as soon as possible, endeavoring at the same time to keep within the meridians of 26° and 28° W., crossing 5° N. near 27° W. Beyond 5° N., and between the same meridians, there are 20 per cent. of calms to be overcome. Continue to make southing, and, at the end of April or the beginning of May, the NE. trades will be lost about 4° N., and the SE. will be reached near 3° 30′ N. on the same meridian. Then make a good run with the sails rap full, but hauling gradually closer to the wind as the trades become more settled. Cross the line between 27° and 28° W.

In *April*, *May*, and *June*, when leaving the straits, moderate weather and few calms will generally be encountered. Cross 35° N. at about 9° W., and steer to pass to the westward of the Canaries. The winds will be found well established from NE., after the meridian of 10° W. shall have been crossed, and the route from the Channel for those months may easily be joined. If it is desired to pass through the Canary group, Palma and Hierro should be left to the westward, and Gomera to the eastward, it must be remembered that light breezes and calms may be encountered to leeward of those islands.

In *May*, when leaving the Channel, steer a course to across the parallels 45° N. at about 12° W.; 42° 30′ N. at 15° W.; 40° N. at 16° W.; 35° N. at 17° W., and 30° N. at 20° W., where well-settled trades will be found. This route leads clear of the unfavorable zone between the parallels of 30° and 45° N., and the meridians of 10° and 15° W. After reaching the trades, vessels should steer to cross 25° N. at 22° W., and 20° N. at 25° W., and to pass to the westward of the Cape de Verde Islands. After passing those islands, if in the month of June, steer south to cross 10° N. between 26° and 27° W.; continuing on this course the trades will be lost when near 8° 30′ N. The zone of calms

should then be crossed as quickly as possible by steering south, clearing it when near 5° N., which should be crossed, at all times, to the westward of 25° W., so as to avoid the unfavorable zone to the eastward of that meridian. After passing 5° N., and being clear of the calms, southing should be made whenever the winds vary from SSW., S., and SE., without particular regard to the longitude, except to avoid crossing the line to the westward of 29° W.

Vessels leaving Gibraltar, and bound to the southern hemisphere, should follow the same route, by conforming to the general instructions given for the months of April, May, and June.

In *June*, the route is about the same as that given for the preceding month. It passes to the westward of Cape de Verde Islands; 15° N. should be crossed at about 26° 20′ W.; and 10° N. at 27° W. From the latter position to 5° N. a zone of calms will have to be crossed, as vessels generally arrive there in July. Make southing as much as possible taking the starboard tack, with SW. winds, not fearing to cross 5° N. at 23°, or even 22° W., but never crossing that parallel as far east as 20° W., because that would lead into the calms and SW. monsoon of the African coast. The SE. trades will be found very soon after passing 5° N., and the line may ordinarily be crossed betweeen 26° and 27° W.

In *July*, when leaving the Channel, a very good course may be made to the westward, if the winds are found from the S. or SSW.; but every advantage should be taken of slants to get to the SSW. to try to cross 45° N. between 10° and 11° W. A course should then be steered to cross 40° N. a little to the westward of 14° W.; pass to the westward of Madeira and cross 30° N. near 18° or 19° W. Then pass on to the westward of the Cape de Verdes, and when beyond the parallel of 15° N. about 12 per cent. of calms and cat's-paws, or light trades, will be encountered, and with them 12° N. may be crossed somewhere between 26° and 27° W. Keeping on between these two meridians, when between 10° and 11° N. the SW. monsoon of the African coast, interrupted by about 8 per cent. of calms, will be encountered, and with it the starboard tack should be taken. In this way a good course may be made, not fearing, if it becomes necessary, to cross 5° N. at 18° or 19° W., taking care, however, never to cross 5° N. to the eastward of 18° W. After having crossed 5° N. the winds will haul to the S. and SSE., when the port tack should be taken so the line may be crossed, as a general thing, at about 24° 10′ W. (This will be in August.)

This route will be all the more advantageous, as the winds on the coast of South America blow more from the southward, and are consequently more unfavorable for vessels crossing the equator farther to the westward, and bound round Cape Saint Roque.

In *July*, *August*, and *September*, when leaving Gibraltar, there are about 10 per cent. of calms to be experienced, so that the first thing to be done when coming out is to use every endeavor to get to the westward, not putting southing into the course until after having passed the me-

ridian of 10° W., as beyond that the winds will be found more favorable, and with less calms. This recommendation applies particularly to sailing-vessels. Having arrived to the westward of the meridian of 10° W., a course may easily be made to pass to the westward of the Canaries, and to join the route of vessels coming from the Channel. If a passage is made through the Canary group, calms and light airs may be expected to leeward of them.

In *August*, when leaving the Channel, vessels will find themselves under very unfavorable circumstances, the winds being contrary, particularly from SW., until they have passed to the southward of 45° N. The best place to cross 45° N. is at 10° W. Then make a southerly course by keeping to the eastward of 17° W., and crossing, if possible, the parallel of 40° N. between 14° and 15° W., and 35° N. at 16° W. The trades will then be entered, and with them a course may be steered to cross 30° N. at 18° or 19° W.; pass to the westward of, and near to, the Cape de Verde Islands, and cross 15° N. between 26° and 27° W. This will be in the month of September, and the trades, intermixed with 12 per cent. of calms, will allow southing to be made as far as 11° N., where they cease entirely; 11° N. should be crossed at 27° W. From this point the SW. monsoon, intermingled with 8 per cent. of calms, will be felt. With this monsoon the starboard tack should be taken, and a course run until the wind hauls to S., SSE., or SE., when the port tack should immediately be taken. The starboard tack, heading ESS. or SE., should not be held long enough to pass to the eastward of 19° W. Every endeavor should be made to cross 5° N. to the westward of 20° or 19° W.; and from there the winds will be from S. to SE.; from 5° N., or below it, the port tack will lead across the line between 22° and 24° W. This is, at this season, the best point of crossing, and vessels may then double Cape Saint Roque with a good full.

For vessels leaving Gibraltar, the course is the same, conforming at all times to what was said in the preceding page for July, August, and September in regard to the first part of the route.

In *September*, when leaving the Channel, vessels should steer to cross 45° N. at 12° W., and 40° N. between 14° and 15° W., so as to avoid the calms which become rather frequent as the coast of Portugal is neared. Then steer to cross 35° N. between 16° and 17° W., and pass close to the western side of Madeira; cross 30° N. at 19° W.; coast along to the westward of the Cape de Verde Islands, and steer a good full, with the trades and 6 per cent. of calms, to cross 10° N. between 24° and 25° W. From this the trades either cease or are on the point of doing so; so 25 per cent. of calms may be counted on, and the winds found will be variable from NE., E., SE., S., and SW. So long as the winds are NE., E., or SE., a good south course may be made on the port tack; but with S. or SW. the starboard tack should be taken immediately, and very probably the vessel will be forced to cross 5° N. at about 17° W. Great care should be taken, at all times, to avoid

getting to the eastward of 20° W., because 28° per cent. of calms will be felt there. Having crossed 5° N. take the port tack with S. and SE. winds, and only 4 per cent. of calms will be felt between 20° and 25° W. and 5° N. and the equator, which should be crossed between 24° and 25° W.

Auxilary steam vessels, by getting up steam, when necessary, about 10° N., may shorten the latter part of this route.

Vessels leaving Gibraltar should refer, for instructions in regard to the first part of the route, to what has been said in the preceding pages, and should then run to join the course as laid down for vessels that have sailed from the Channel.

In *October*, when leaving the Channel, very heavy weather from SSW. to NNW. may be expected between the parallels of 50° and 45° N. As a general thing, the weather will be contrary until 35° N. is crossed, and the passage will be long and tedious. Vessels will be forced to cross 45° N. between 12° and 13° W., and 40° N. at 15° W. From this point the course should be to the southward, by short tacks if necessary, so as to cross the parallel of Cape St. Vincent between 15° and 20° W., and 30° N. at 18° or 19° W.

Pass to the westward of Madeira, about the locality of which 10 per cent. of calms may be looked for. In October, rains and winds turning from SE. to NW. through W. will be experienced. In November, the weather will be fine, with NE. winds, sometimes interrupted by SW. gales.

The parallel of 25° N. should be crossed between 19° and 20° W., and 20° N. at 21° W.; run before the winds inshore, or to the eastward of the Cape de Verde Islands, and then there will be 9 per cent. of calms, with winds varying from NNE. to ENE., with which 10° N. should be crossed between 23° and 24° W. Having arrived at this latter point, toward the end of October or beginning of November, a very unfavorable zone, containing 24 per cent. of calms and winds varying from SE., S., SW., NE., and E., will be entered. The course to be taken will then evidently be due south; nothing could be easier with the wind at E. or NE.; but when it hauls to S. or SW. (which is more often the case), or even to SSW., the starboard tack should be taken so as to gain a favorable position, from which the port tacks may be brought aboard so soon as the winds haul to SE. The winds will generally prevail from S. and SSE., so 6° or 7° N. may be crossed at 23° or 24° W.; and by going about, 5° N. may be crossed at 24° or 25° W. In the zone between 10° and 5° N. and 20° and 25° W., vessels may expect to be retarded a great deal; but by comparing it with the more westerly but equally unfavorable zone, it will be seen that the former has the advantage of placing vessels in a much better position as regards the SE. trade-winds. The winds will be found from SE., when between 23° and 24° W., at about 6° N., or even sooner; then keeping a good full, a good course may be made, without any fear regarding

Cape Saint Roque. Between 5° N. and the equator there will be about 10 per cent. of calms; the line should be crossed between 26° and 28° W.

Vessels leaving the straits in *October*, *November*, and *December* will find the winds exceedingly variable; the most frequent are those from NW.; there are, however, but 5 per cent. of calms. A course should first be made to cross 34° N. at about 11° W., and from there to pass near the Canaries, where the winds will be found from NNE. to NNW., mingling with the trades. Great care should be taken in these localities, and especially in December, to guard against SE. and SW. gales of wind. Then join the route as given in detail for vessels leaving the Channel.

In *November* the weather will be very unfavorable for vessels leaving the Channel. We advise, in a general way, to make, first, to the westward as much as possible and to cross 45° N. at 12° W.; 40° N. to the westward of the meridian of 16° W.; 35° N. at 18° W.; and 30° N. at 20° W.

Having arrived at this latter point, in the last half of November, run to pass to the westward of the Cape de Verde Islands, and to cross 10° N. a little to the westward of 25° W. The zone between 10° and 5° N. is then entered, in which there are 17 per cent. of calms and variable winds, and frequently from the eastward, and with them a southerly course may be made to about 6° N., where the winds begin to haul to S. and SE. The port tack should soon be taken, and no more than 10 per cent. of calms will be experienced up to the equator, which should be crossed to the westward of 26° W. There is an advantage, toward the end of November or the 1st of December, in crossing the line to the westward, that is to say, between 26° and 28° W., because the winds generally haul to the eastward at this season when approaching the coast of Brazil.

Vessels sailing from Gibraltar may take the same route, by following the courses, for the first part of it, as laid down for October, November, and December.

In *December*, between 50° and 45° N., SW. storms are very frequent; every effort should be made to cross 45° N. at 10° or 10° 30′ W.; 40° N. between 14° and 16° W.; 35° N. between 17° and 18° W.; and 30° N. at 19° W., where the trades will in all probability begin to be felt. Vessels may pass either side of the Cape de Verde Islands (this will be some time in January), and run to cross 10° N. at 25° W., and 5° N. at 25° or 25° 30′ W. The NE. trades will not begin to die out before reaching this latter point; after which about 16 per cent. of calms may be expected. Making southing as quickly as possible, avoid getting to the eastward of 25° W., where there are 21 per cent. of calms. The NE. trades will generally be lost at about 4° N., and the SE. trades found at about 2° N. With the latter the port tack is taken to cross the line as soon as possible between 26° and 27° W., so as to be in a good position to make a course to the southward.

Route from the equator to France.—The voyage from the equator to the Channel, or to the Straits of Gibraltar, is quite easy. It may be given, in a general way, in a few words: Cross the equator between the meridians of 24° and 26° W.; stand on with a good full, close-hauled on the starboard tack, after the trades are reached, and make northing until the winds are found to haul to the southward and westward, which takes place about 35° N., and from there run for the Channel or the straits.

Auxiliary steam vessels may shorten this voyage by the aid of steam when crossing the equatorial calms and those between 25° and 35° north latitude. This latter part concerns vessels bound to the straits, which may thereby avoid, in a great measure, the large detour which marks the passages to the westward of the Azores.

We shall give for each month of the year the points of crossing for the different parallels, to be followed as closely as possible by vessels coming from the southern hemisphere. These are, for the most part, taken from the instructions issued by the Utrecht Observatory. It will be noticed that they lead through longitudes much farther to the westward than were previously given for the return from the Gaboon River. (See from the Gaboon to France, p. 67.) The western route is the better for vessels bound to the Channel. But the eastern one should be preferred by fine sailing or good auxiliary steam vessels when bound to Gibraltar. Either may be taken, but we strongly recommend not to take an intermediate one.

In *January* the line should be crossed at 24° 30′ W.; the SE. trades will be lost at 2° N. and 25° W., and 18 to 20 per cent. of calms will be experienced as far as 5° N. Near 4° 30′ N. light NE. airs will begin to be felt; and, taking the starboard tack, the following crossings may be made: 10° N. at 28° 30′ W.; 15° N. at 33° W.; 20° N. at 36° W.; where the winds will be found quite variable, but generally easterly and with 7 per cent. of calms; then 25° N. at 37° 15′ W., about which place the winds will be found from NNE., ENE., ESE., SSW., and occasionally from WNW. and WSW., with 7 per cent. of calms; and 30° N. may be crossed between 37° and 38° W. Having arrived at this latter point, vessels bound to Gibraltar should run with the winds generally from SSW. to ESE. to cross 32° 45′ N. at 30° W.; after which, with winds variable, but oftener favorable than otherwise, they may cross 34° N. at 25° W.; 35° 30′ N. at 20° W.; and from there may steer for the point where they intend to make the land-fall (generally Trafalgar).

Having arrived at 30° N. and 37° 10′ W., vessels bound to the Channel should stand on, with favorable winds, to cross 35° N. at 37° W.; 40° N. at 35° W.; 42° 30′ N. at 32° 30′ W.; 47° 30′ N. at 22° 30′ W.; 49° N. at 15° W.; 49° 15′ N. at 10° W.; and 49° 25′ N. at 5° W.

In *February* the line should be crossed at 24° W.; the SE. trades will be lost near 1° 30′ N. and 24° 20′ W., and 18 per cent. of calms

will be experienced until the parallel of 5° N. is reached; about 3° N. and 25° W., the winds will begin to be well established from the eastward. The starboard tack should then be taken, and a course made to cross 10° N. at 28° 30′ W.; 15° N. at 36° 15′ W.; 20° N. at 41° W.; and 25° N. at 42° W. The wind will then commence to become variable; though predominating from ENE., ESE., SE., and SSE., they sometimes blow from SSW. to NNW.; 7 per cent. of calms will be encountered until 30° N., which should be crossed at 40° W., is reached.

Arrived at this latter point, vessels bound to *Gibraltar* should run, with the winds generally favorable, to cross 32° 30′ N. at 35° W.; 33° 30′ N. at 30° W.; 35° 30′ N. at 20° W.; and from there for the land-fall point (Trafalgar).

Vessels bound to the *Channel*, after having reached 30° N. and 40° W., should steer, with variable winds, but generally from WSW. to SSE., so as to cross 35° N. at 57° W.; 40° N. at 31° W.; 42° 30′ N. at 26° 30′ W.; 45° N. at 21° 10′ W.; 47° 30′ N. at 15° W.; and 49° 25′ N. at 5° W.

In *March* the line should be crossed at 24° 30′ W., and the SE. trades will be lost when near 0° 30′ N. and 25° W., between which place and 5° N. from 16 to 18 per cent. of calms will be felt. The NE. trades will probably be found about 2° or 2° 30′ N., and that parallel should be crossed, if possible, at 25° 10′ W. From 5° N. well-established winds, blowing from E. and NE., will be found, with which vessels can stand on without difficulty to 10° N., crossing that parallel about 35° W. The same winds will permit 15° N. to be crossed at 40° W.; after which they will be found to vary from E. to NE., interrupted by occasional SE. breezes, with which a vessel may readily shape a course to cross 20° N. at 41° W. Winds from ENE. and ESE. may then be expected, by means of which 25° N. may easily be reached at or about 41° 30′ W. From there to 30° N. the winds will be variable, but predominating from ENE., ESE., and SE., and blowing occasionally from SSW. and NNW., with 7 per cent. of calms.

Having arrived at 25° N. and 41° 30′ W., vessels bound to *Gibraltar* should steer to cross 30° N. at 40° W.; and 32° 30′ N. at 35° W.; and then finish their voyage as pointed out for the preceding month, making the land at Trafalgar.

Vessels bound to the *Channel*, after having reached 25° N. at 41° 30′ W., should run to cross 30° N. at 42° W.; 35° N. at 41° 30′ W.; 40° N. at 37° 30′ W.; 42° 30′ N. at 35° W.; 45° N. at 30° W.; 47° 30′ N. at 25° W.; 48° 40′ N. at 20° W.; 49° N. at 15° W.; and 49° 25′ N. at 5° W.

In *April* the equator should be crossed at 24° W.; the SE. trades will be lost at 1° 20′ N. and 25° W., and 20 per cent. of calms will then be experienced until the parallel of 5° N. is reached. The NE. trades may be expected at 2° 30′ or 3° N., which ought to be crossed at 25° 10′ W. Beyond 5° N. the winds will be from E. and NE., well established, but with 12 to 14 per cent. of calms up to 10° N., which last

should be crossed at 32° 30′ W. The same winds, but without any chances of calms, will permit crossings as follows: 15° N. at 37° 30′ W., and 20° N. at 40° W. From 20° to 25° N. there will be 10 per cent. of calms, with winds predominating from ENE., varying to NNE., ESE., and SSW.; and 25° N. may be crossed at 41° 30′ W. From 25° to 30° N., which should also be crossed at 41° 30′ N., 13 per cent. of calms will be found, with winds prevailing from NNE., ENE., and ESE., and occasionally from SSW., WSW., and WNW.

Having arrived at 30° N. and 41° 30′ W., vessels bound to *Gibraltar* should run, with favorable winds, to cross 35° N. between 39° and 40° W.; they should then cross 36° N. at 30° W., and steer to make the land either at Trafalgar or Spartel. The winds will most always be fair, but there are about 8 per cent. of calms south of the Azores.

Vessels bound to the *Channel*, leaving 30° N. and 41° 30′ W., should run, with favorable winds and few calms, to cross, successively, 35° N. at 41° 30′ W.; 40° N. at 35° W.; 43° 30′ N. at 30° W.; 47° 30′ N. at 20° W.; 48° 45′ N. at 15° W.; 49° 15′ N. at 10° W.; and 49° 25′ N. at 5° W.

In *May* the line should be crossed at 24° W.; the SE. trades will be lost at 2° 30′ N. and 26° W., and 19 per cent. of calms will be felt until 5° N. shall have been crossed at or about 26° or 27° W. From there winds from E. and NE., with 8 per cent. of calms, will be experienced, and 10° N. may be crossed at 30° 30′ W. A good course may then be made with the trades well established, crossing 15° N. at 38° 30′ W., and 20° N. at 41° W.

From this point the same chances of winds and calms as given for the last month will be experienced.

Vessels bound to *Gibraltar* will cross 25° N. at 41° 15′ W.; 30° N. at 41° 30′ W., and then continue as laid down for the month of April.

Vessels bound to the *Channel* should cross 25° N. at 41° 15′ W.; 30° N. at 41° 30′ W.; 35° N. at 41° 15′ W.; 40° N. at 35° 30′ W., and end as directed for April.

In *June* the equator should be crossed at 23° W., by vessels coming from either Cape Horn or Cape of Good Hope, but farther to the westward by those coming from the coast of South America. They should all try to cross 5° N. at 25° 45′ W., where the SE. trades will be lost, and winds predominating from E. and ENE., and occasionally from S. and N., intermingled with from 10 to 14 per cent. of calms, will be experienced. Steer north, through the light-air region, and take the starbord tack when the NE. trades become well established. 10° N. should generally be crossed between 27° and 30° W.

Leaving this latter point, *vessels bound to Gibraltar* should run to cross, successively, 15° N. at 30° 30′ W.; 20° N. at 35° W.; 25° N. at 37° 30′ W.; 30° N. at 40° 45′ W.; 35° N. at 37° W.; and 36° N. at 30° W. Following this route, when between 20° and 25° N., there will be found about 6 per cent. of calms, with winds from ENE., sometimes inter-

rupted by those from ESE.; between 25° and 30° N. there will be 13 per cent. of calms, and winds predominating from ENE., ESE., and SSW.; between 30° and 35° N. there will only be 6 per cent. of calms, and the winds will become more and more favorable as northing is made. From 36° N. and 30° W., a course may be steered, with winds most always fair, for the land-fall of the straits (either Trafalgar or Spartel). To the southward of the Azores there are 8 per cent. of calms.

Vessels bound to the *Channel*, after leaving 10° N. between 27° and 30° W., will make a good course to the NW., carrying studding-sails when possible, crossing, successively, 15° N. at 32° 30′ W.; 20° N. at 37° 30′ W.; 25° N. at 40° 30′ W.; 30° N. at 42° 45′ W.; 35° N. at 42° W.; 40° N. at 40° 15′ W.; 45° N. at 30° W.; 47° 30′ N. at 20° W.; 49° N. at 10° W.; and 49° 25′ N. at 5° W. Following this route there will be, when between the parallels of 20° and 35° N., about 6 per cent. of calms, with winds from ENE., varying to ESE. Then between 25° and 30° N. about 13 per cent. of calms, with winds predominating from NNE., ENE., and ESE., often varying to SSW., WSW., and WNW. Beyond 30° N. there will be only 6 per cent. of calms up to 35° N., and the winds from that point to the Channel are nearly always favorable. Consequently, vessels may soon run down their longitude. When about the locality of 40° N. and 40° 15′ W., a good watch should be kept for icebergs, which sometimes reach this extreme limit. They need not be feared after passing to the eastward of the meridian of 38° W.

In *July* the equator should be crossed about 21° W., by vessels coming from Cape Horn or the Cape of Good Hope, but farther to the westward if coming from Brazil. Then with the winds from S. and SE., steer to cross 5° N. at 23° W. Beyond 5° N. there are but 8 per cent. of calms, with winds from S. and SW., with which vessels may easily run to cross 10° N. between 24° and 25° W. After this they should steer, as nearly as possible, due N., with variable winds and 11 per cent. of chances of calms, until the NE. trades are found, generally at 12° or 13° N., when the starboard tack should be taken, and 15° N. crossed between 26° and 29° W. To the northward of 15° the trades will be found well established from NNE., varying to ENE., E., and ESE., up to 20° N., which should be crossed at 32° 15′ W.; the trades will then blow from NNE. to ENE. up to 25° N., which may be crossed at 34° 30′ W. Between 25° and 30° N. there will be about 8 per cent. of calms, and with the winds from ENE. and ESE., varying to NNE. and SSW.; 30° N. may then be easily crossed at 36° 30°′ W., and 35° N. at 35° 30′ W

Having arrived at 35° N. and 35° 30′ W., vessels bound to *Gibraltar* should keep off to starboard and run, with winds generally from SW., to cross 36° N. at 28° W.; 36° 30′ N. at 25° W.; 37° 30′ N. at 20° W. then making an east course, with winds first from NE. then from N., until the meridian of 15° W. is reached, from which place they may run direct for a land-fall. There will be 8 per cent. of calms to the south

ward of the Azores, and 9 per cent. at the mouth of the straits. (See the following month for the last part of this voyage.)

Vessels bound to the *Channel*, after having passed 35° N. and 35° 30′ W., should steer, with winds generally favorable, to cross 40° N. at 28° W.; 41° 45′ N. at 25° W.; 45° N. at 18° W.; 47° 30′ N. at 12° W.; and 49° 25′ N. at 5° W. They should avoid as much as possible the zone between 40° and 45° N. and 25° and 30° W., where they will be exposed to 9 per cent. of calms.

In *August*, when coming from either of the capes, the equator should be crossed between 20° and 21° W., but when coming from Brazil, a little farther to the westward. The SE. trades will be lost at 2° 30′ N. and about 22° 10′ W.; then until 10° N., which should be crossed at 23° or 25° W., is reached, there will be 8 per cent. of calms, with the winds hauling to S. or SW. Beyond 10° N. and to 12° 30′ N., where the NE. trades will be found, there will be from 10 to 11 per cent. of calms, when between the meridians of 25° and 28° W.

Vessels *bound to Gibraltar* should steer as nearly as possible to cross 5° N. at 22° 15′ W.; 10° N. at 23° 15° W.; 15 N. at 26° 15′ W.; 20° N. at 30° 30′ W., and 25° N. at 33° 30′ W. Beyond the parallel of 27° 30′ N. the trades will commence to be variable, with 8 per cent. of chances of calms; however, the winds will always prevail from NNE. to ENE., and with them 30° N. may easily be crossed at 34° W. There will then be only 5 per cent. of chances of calms, and the NNE. winds will often, or rather generally, haul to ESE., SSE., or even SSW., with which 35° N. may be crossed at 32° or 33° W., and 36° N. between 28° and 30° W. This is just to the southward of the Azores, where there are 8 per cent. of calms, with favorable winds from SSW. to WSW., with which 36° 30′ N. may be crossed at 25° W.; beyond this point there need be no fear of calms, while the winds, prevailing from NNW. and SSW., will permit 37° 30′, or even 38° N., to be crossed at 20° W. Vessels are thus placed in the most advantageous position for running for the land (Trafalgar oftener than Spartel). Really, the prevailing winds between 20° and 15° W. are those from NE., and the exceptional ones, those from E., NW., and SW., which will allow only an ESE. course to be made. Between 15° and 10° W. the prevailing winds are from N. and ENE., and the occasional ones from the NW., so the route may *usually* be due E. Finally, after the meridian of 10° W. is passed, there will be but 9 per cent. of chances of calms, with winds predominating from NNE., and blowing occasionally from SE., SW., NW., E., and W. When entering the Mediterranean the winds blow 26 per cent. from the westward, 52 per cent. from the eastward, and there are 21 per cent. of chances of calms.

Those vessels which are bound to the Channel should follow as nearly as possible this route, viz: Cross 5° N. at 24° 45′ W.; 10° N. at 25° 30′ W.; 15° N. at 29° 30′ W.; 20° N. at 29° 30′ W.; 25° N. at 36° 15′ W.; 30° N. at 37° 45′ W.; 35° N. at 38° 30′ W.; 40° N. at 34° W.;

42° 30′ N. at 30° W.; 45° N. at 25° W.; 47° 30′ N. at 20° W., 49° N. at 10° W., and 49° 25′ N. at 5° W.

On this route, when between 25° and 30° N., there will be about 8 per cent. of chances of calms, with the winds from NNE., ENE., ESE., and SSW., and some chances of occasional WNW. winds. Between 30° and 35° N. there will be 7 per cent. of chances of calms, and winds predominating from ENE., ESE., and SSE., with a few exceptional NNE. and WSW. breezes. Beyond 35° N. and up to the Channel the winds will nearly always be fair, and there need be no fear of calms, except between 42° 30′ and 45° N., where there are about 9 per cent.

In *September*, when coming from either cape, the equator should be crossed at 21° 50′ W., but farther to the westward when coming from Brazil. All vessels should cross 5° N. between 22° and 23° W. As a general thing, the SE. trades will have hauled to the southward by the time 5° N. is reached, but beyond that parallel the wind becomes the SW. monsoon, and only 8 per cent. of chances of calms need be expected until 10° N. is crossed at or about 22° 30′ W. Beyond 10° N. the chances of calms increase to 11 per cent.; and when 11° N. is reached the SW. monsoon may be expected to be replaced by winds from NNW. and NNE., with which the starboard tack should be taken, endeavoring to make all the northing possible. After passing to the westward of the meridian of 25° W. there will be 12 per cent. of calms, with winds prevailing from E. and NE.; and with them as much northing as possible should be made, so as to cross 15° N. about 26° 30′ W. Beyond 15° N. the calms end, and the trades will be found blowing steadily from NNE., and hauling to ENE. as northing is made. Cross, successively, 20° N. at 29° W.; 25° N. at 32° 15′ W.; 30° N. at 32° 30′ W.; 35° N. at 32° 15′ W. In following this route, and when between 25° and 30° N., the trades from ENE. to NNE. are exceptionally interrupted by 9 per cent. of calms. From 30° to 35° N. there will be but 5 per cent. of calms, and the prevailing winds are from NNE., ESE., and SSE., with occasional SW. breezes.

Vessels *bound to Gibraltar* having arrived at 35° N. and 32° 15′ W. should steer to cross 36° N. between 28° and 30° W., and from there may run to make the land (Trafalgar), following the directions as given for the month of August. The chances of calms and probable direction of the winds are about the same in September as in August.

Vessels *bound to the Channel*, after having crossed 35° N. and 32° 15′ W., should run, with winds blowing generally between SSE. and WSW., to cross 38° 45′ N. at 30° W.; then, with favorable winds, they should steer to cross 42° 30′ at 21° 30′ W.; 45° N. at 17° 30′ W.; 48° 30′ N. at 10° W., and 49° 25′ N. at 5° W. In following this route there will be from 8 to 9 per cent. of chances of calms, when crossing the zones limited by the parallels of 40° and 45° N., and between the meridians of 25° and 30° W., and 15° and 20° W. However, the route as given only passes through the angles of these squares.

In *October* the equator should be crossed between 22° and 24° W., after which 14 per cent. of calms, with the SE. trades well to the southward, will be experienced, and a course should be made to cross 5° N. at 26° W. From this point the SE. trades will be lost entirely, and a mean of 21 per cent. of chances of calms, with exceedingly variable breezes, blowing mostly, however, from the eastward, may be expected; 10° N. should then be crossed at about 26° W., where the trades will be found, prevailing from E. and NE., with only 6 per cent. of calms. Then cross, in succession, 15° N. at 28° 30′ W.; 20° N. at 31° 30′ W.; 25° N. at 35° 30′ W.; and 30° N. at 36° 15′ W. This route may easily be made, as the trades are generally well established. They will be found blowing from E. and ENE. as far N. as 20°; then, from 20° to 30° N., they will *prevail* from NE., sometimes varying to ESE. and NNE.; finally, from 25° to 30° N., they will blow from NNE., ENE., and ESE., and sometimes, but rarely, the wind will be from between SSW. and WNW. All of these latter, however, are favorable.

Having arrived at 30° N. and 36° 15′ W., vessels *bound to Gibraltar* should steer, with winds predominating from S., but occasionally from ENE., ESE., WNW., and WSW., in such a manner as to cross 35° N. at 32° 30′ W. From this place to the straits fair winds, with few if any calms, will be experienced, provided vessels cross 36° N. at 30° W., and run down their easting on or about the parallel of 36° N. In case of head-winds the starboard in preference to the port tack should be taken so as to avoid the parallel of 35° N., below which calms and unfavorable winds will be found. Make the land at Trafalgar.

Vessels *bound to the Channel*, after having reached 30° N. at 36° 15′ W., will find 7 per cent. of calms, with winds predominating from SSE. to SSW., with which they may easily run to cross 35° N. at 35° 45′ W. The winds will then be from ESE., SSE., and SSW., and no calms will be felt until 40° N. is reached, which should be crossed at 32° 05′ W. After this 6 per cent. of calms, with winds from S., SW., and WNW., will be found, and with them 42° 30′ N. may be crossed at 30° W.; then 8 per cent. of calms, with winds from W., N., and S., which will generally allow 45° N. to be crossed at 27° 30′ W. From this point to the Channel there will be constantly favorable winds, with few, if any, calms; so that 47° 30′ N. may be crossed at 17° 30′ W.; 49° N. at 10° W., and 49° 25′ N. at 5° W.

In *November*, when coming from the cape, the equator should be crossed between 22° and 23° W., but a little farther to the westward when coming from Brazil. The chances of calms and winds will be the same as were given for October; the route to be followed will also be about the same, except that it is slightly to the westward. The SE. trades, varying to the southward, will be lost at about 3° 30′ N., and between 25° and 26° W. At first there will be 13 per cent. of chances of calms, until 5° N., which should be crossed between 25° and 26° W., is reached; then 17 per cent. of calms to 6° or 7° N., where southerly

breezes take the place of those from ESE., E., and NE., and with these 10° N. may be crossed at or about 26° 15′ W. The starboard tack should then be taken, and with a good full through the trades, the parallels may be crossed as follows, viz: 15° N. at 31° W.; 20° N. at 34° 15′ W.; 25° N. at 36° W., and 30° N. at 37° W. As was said for October, this route may easily be followed, with winds generally well established, and blowing from E. and ENE., as high as 15° N.; then from ENE. to ESE. up to 20° N.; from NNE., ENE., and ESE., with 7 per cent. of calms up to 25° N.; and, finally, between 25° and 30° N., the winds will be well established from NNE., ENE., ESE., and sometimes from WNW. and SSW.

Having arrived at 30° N. and 37° W., vessels bound to *Gibraltar* and the *Channel* should continue their respective voyages as pointed out for the month of October.

In *December* the equator should be crossed between the meridians of 23° and 25° W., according to where the vessel sailed from; but all of them should profit by the SE. trades, varying to S., to cross 3° N. at or about 25° W.; from which place to 5° or 6° 30′ N., which should be crossed about 26° W., from 12 to 20 per cent. of calms will be experienced. From the latter point to 10° N., which should be crossed at or about 27° W., the trades will blow from the eastward, varying from SE. to NE., with some few southerly breezes. Above 10° N. the starboard tack should be taken, and with a good full, cross, successively, 15° N. at 33° W.; 20° N. at 37° 45′ W.; 25° N. at 40° 30′ W.; and 30° N. at 41° W. In following this route, after 15° N. and 35° W. shall have been passed, the winds will be found to predominate from E., varying, however, at times to NE. with 8 per cent of calms. Beyond 20° N., there will be 8 per cent. of calms, with the winds predominating from ENE., but varying to ESE. and NNE. Between 25° and 30° N. there will be but 5 per cent. of calms, with winds from NNE. to ESE., and occasional breezes from WNW. and SSW.

Vessels bound to *Gibraltar* may generally cross 30° N. a little farther to the eastward, say 40° W., for example. From this point they will encounter 7 per cent. of calms, with winds predominating from ENE., SE., and SSW., with which they may run to cross 43° 30′ N. at 35° W.; then, with predominating southerly and occasional easterly or westerly winds, they may run to cross 45° N. at 31° W., and 46° N. at 29° 10′ or 30° W. After that they may steer for the straits, with fair winds, as pointed out for October, making the land generally at Trafalgar.

Vessels bound *to the Channel*, after having passed 30° N. and 41° W., should run, with winds predominating from ESE. to SE., so as to cross 32° 30′ N. at 40° W.; then, with SSE. and SSW. winds, interrupted by 7 per cent. of calms and by breezes from ENE. and WSW., they may run to cross 35° N. at 38° 30′ W. Beyond 35° N. the winds will be well established, generally from SSE. and SSW., but sometimes from ESE. and WNW., with which 40° N. may be crossed at 35° 45′ W.

There will then be 6 per cent. of calms, with winds from S., SW., and WNW., and 45° N. may be crossed at 30° W. From there to the Channel the winds will be westerly, and vessels may cross 47° 30′ N. at 20° W.; 49° N. at 10° W., and 49° 25′ N. at 5° W.

Route from New York to the equator.—This route, as is well known, is the *chef-d'œuvre* of Maury. We do not think that any seafaring man will find this too strong an expression. It was really this route which began, and established, the universal reputation of that American savant. It made him a public benefactor, for to citizens of the United States the question of reducing the passage to the line from forty-one to thirty-one days was indeed a most important one; and the news of this grand result was, to other maritime nations, the signal for general study on the subject of nautical meteorology. A study which, though fruitful, is to-day far from having given the results which we have a right to expect from it. We shall change but slightly the terms used by Maury; and in what follows there will be found in a condensed form a reproduction of his own instructions:

The point of departure is supposed to be New York. Vessels leaving other United States sea-ports must profit by local winds to place themselves in the indicated positions. Those leaving southern ports should not try to reach the indicated route to the southward of 33° N., on account of the persistent calms of those regions. When starting, *with a good wind*, particularly from New York and Boston, vessels bound to the southern hemisphere will do well, the wind permitting, to steer east, without trying to make any latitude, until the meridian of 60° W. is reached. The degrees of longitude being shorter in the higher latitudes, there is an advantage, *when the winds permit*, in pushing on to 60° or even 50° W., before crossing 40° N. This advice is applicable to all months of the year, and also when the winds are southerly.

Starting from the United States, vessels should not, unless forced by contrary winds, cross 20° N. to the eastward of 35° W. In winter, and spring particularly, the line may be reached in the shortest possible time by crossing this parallel rather to the westward instead of the eastward of that meridian; and further, by crossing to the westward, the passage from the United States to the parallel of 20° N. itself will be from 8 to 10 days shorter than when forced to cross it farther to the eastward.

Captains desiring to make use of the routes to be given farther on, should trace them on the chart, and then draw a line from Cape Saint Augustin (Brazil) to the equator, touching at the point where they wish to cross it, and should then endeavor to keep that line to leeward of them all the time, so that it shall be at least 20 or 30 miles to the westward when they can cross the parallel of 6° or 7° south. The winds will then haul to the eastward, and a SSW. or even a south course may easily be made.

When driven to the westward of this line, they should profit by the variations of the wind to make easterly boards until they double the land. This point may be called the turning point of the route. Vessels may, almost always, when between the equator and 6° S., make SSW. on one tack, and E. on the other. Unless an insufficient amount of southing has been made, these boards need not be prolonged to the eastward farther than to a line 20 or 30 miles to leeward of the line drawn from 31° W. on the equator to Cape Saint Augustin. These instructions, it should be well understood, are only applicable to vessels which can lie *within six points of the wind*. Vessels of *inferior sailing qualities*, trying to run by them, will be forced *very far to leeward*, and can only regain a favorable position after great trouble and loss of time.

We also desire to impress upon navigators who may put our recommendations in

practice the great advantage there is, when below the line, in standing boldly to the southward, without trying to make easting by taking the northerly tack. It will be plenty of time to think of that after the land is recognized and they find themselves to leeward of the point; besides, when near the land, vessels will be able to make to windward faster by taking advantage of the more frequent variations in the direction of the winds.

Suppose a vessel crossing the line at 32° or 33° W. finds the trades blowing really from SE.; heading SSW. puts her in a position to profit by every variation of the breeze; if it hauls to the eastward she will double the land; if, on the contrary, it hauls to the southward, she may take the port tack, make to the eastward, and gain rapidly by making unequal boards. Our researches show us that *to seaward* of Cape Saint Roque, and *in the fairway from the equator to the southward*, there are rarely strong currents; in fact many navigators have made the passage without experiencing any at all. But in that locality a good lookout should be kept for, and proper attention should be paid to, currents setting on shore; but, as a general thing, we may say that obstacles of this nature to be met with in these localities are neither dangerous nor difficult to overcome.

Crossing the line between 33° and 34° W., Cape Saint Roque will bear SSW., so that, without counting leeway, the wind would have to remain at SE. in order to prevent vessels from weathering it; *this does not happen once in a hundred times.* If the wind hauls to ESE. it may easily be doubled; if it hauls to SSE. the port tack should be taken to stand to the eastward.

Maury then gives the tracks of 365 vessels, one for each day of the year. Of this number only four fell to leeward of Cape Saint Roque, and these, as an average, only lost three days on their voyage up to the time of doubling the cape; and that, too, notwithstanding the mean longitude of their crossings of the equator was a little to the westward of 36° W. Nevertheless, the mean of the passages of these four vessels from the United States to the parallel of Cape Saint Roque was shorter by a week than those by the old route.

If we take the six best passages of each month, we have, for 72 vessels, a mean of 24 days to the equator, and the mean longitude of their crossing the meridian of 30° 50′ W.; that is to say, only 30′ to the westward of the mean of the whole 365 vessels. The most favorable months are those from November to May, inclusive, giving from 20 to 22 days; the worst are those from June to October, giving from 25 to 31 days. The most westerly longitude of the different *means* for the crossing of the equator was 32° 13′ W.; this was that of the *best six* of December.

The routes given farther on show, from May to December, inclusive, that the parallel of 5° N. is crossed farther to the eastward than the equator. The reason is found in the monsoon of the equatorial calm region, and from this we draw a general rule, viz, when the parallel of 10° N. is crossed at 30°, 31°, or 32° W. to make to the southward, it is unnecessary to go any farther to the eastward. It is evident that if the SW. monsoon is encountered (which sometimes happens in summer and autumn), and the vessel is at 32° W., it will be necessary to take the easterly tack; but if the vessel is at 30° W. it is necessary to always choose the tack on which the most southing may be made, so as to cross the calms as quickly as possible; and if this tack does not throw the vessel to the westward of 31° or 32° W. she may consider herself as in a good position to clear this zone of calms and light breezes.

These are, as a whole, the instructions of Maury on the route which he studied most carefully, and for which he gave the most complete and best-reasoned instructions. However, to complete these useful notices to mariners on this route, we think it best to insert a note by M. Mouchez,

captain in the French navy, which appeared in the *Annales hydrographiques* (first quarter, 1866):

Numbers of vessels have been lost on the reefs and rocks off Cape Saint Roque, *within the last few years;* the greater part of the débris of wrecks seen on the rocks are of recent date, and it is well known among the inhabitants of the coast that vessels run aground much more frequently now than formerly. This is explained very naturally by the exaggeration of the rules of navigation which Captain Maury has made common and sought to have adopted. By insisting that there was not the slightest inconvenience to be encountered in crossing the line to the westward of the limits heretofore admitted, many vessels, either from contrary winds, westerly currents, or perhaps bad sailing qualities, have been unable to weather Cape Saint Roque, and have been obliged to put about by the nearness of the outlying reefs. The chances of shipwreck are thus infinitely greater than when, crossing the line at 23° or 24° W., the cape was doubled some 60 or 80 leagues distant. We believe that 28° or 30° W. is the limit which should never be passed. A high light on the most northeasterly reef off Cape Saint Roque would be *one* of the most, if not *the* most, useful light on the coast of Brazil.

Thus we should guard against the general tendency to *exaggerate* the rules of Maury for this passage. We should not, however, lose sight of the fact that his instructions were intended more for clippers; that is, sailing-vessels of the very finest sea-going qualities. Consequently a medium vessel should prefer a route a little farther to the eastward; and on this subject we shall cite the route, from the Channel to the equator, as one worthy of being consulted.

Having made these few observations, we proceed to point out, for each month of the year, the mean route of vessels which followed Maury's instructions, adding something on the principal chances of winds and calms to be encountered, when making these voyages. It must be well understood that vessels should not be too particular about following these routes exactly, but if contrary winds are met with must try to regain it and follow its general direction as nearly as possible.

In *January*, cross 30° N. at 41° 49′ W.; 25° N. at 40° 13′ W.; 20° N. at 37° 56′ W.; 15° N. at 35° 35′ W.; 10° N. at 33° 41′ W.; 5° N. at 30° 47′ W., and the line at 30° 06′ W.

In order to follow this route it will be necessary, first, to steer to the eastward, keeping north of the parallel of 40° N., to about 55° W., and then to cross 35° N. as near as possible to 50° W., and 30° or 31° N. at 45° W. Beyond this meridian, and between 35° and 30° N., the winds predominate from SSE., and vessels may be forced to make either SW. or easterly boards, but in all cases it will be necessary to work across 26° N. at or about 40° 15′ W., in order to soonest find the trade-winds. Between 30° and 25° N. there will be 7 per cent. of calms, with the winds predominating from ENE. to ESE. Between 25° and 20° N. there will be from 6 to 7 per cent. of calms, and wind predominating from ENE., but varying to NNE. and SSE. Between 20° and 5° N. the trades will be well established, blowing from E. to NE. without calms. Between 5° N. and the equator there will only be 9 per cent. of calms, with winds turning from NE. to ESE. In this month the NE.

trades will generally be lost at 2° 20′ N. and about 30° 15′ W., and the SE. trades will be found at 1° N. and 30° 15′ W.

In *February*, cross 30° N. at 43° 20′ W.; 25° N. at 36° 30′ W.; 20° N. at 36° 10′ W.; 15° N. at 33° 45′ W.; 10° N. at 31° 13′ W.; 5° N. at 29° 26′ W., and the equator at 29° 17′ W.

Leaving New York, the course should again be to the eastward, above 40° N. to about the meridian of 55° W., and the directions for January should be followed until 30° N. is reached. Between 30° and 27° 30′ N., which would be crossed at 40° W., there will be 7 per cent. of calms, with winds predominating from ENE. to ESE. Between 27° 30′ and 25° N., which latter should be crossed at 36° 30′ W., there will be 8 per cent. of calms, with the winds variable from NNE., ENE., ESE., and SSW. Between 25° and 20° N., crossed at 36° 10′ W., there will be 7 per cent. of calms, with winds predominating from ENE., but varying at times to NNE. and SSE. Between 20° and 5° N. the trades will be well established, blowing from E. and NE. Between 5° N. and the equator there will be 16 per cent. of calms, and the winds will haul from NE. to E. and SE. In this month the NE. trades will generally be lost at 2° 30′ N. and 29° 20′ W., and the SE. trades will be found at 1° 20′ or 1° 30′ N. and 29° 20′ W.

In *March*, cross, in succession, 30° N. at 41° 55′ W.; 25° N. at 37° 08′ W.; 20° N. at 35° 26′ W.; 15° N. at 33° 26′ W.; 10° N. at 31° 20′ W.; 5° N. at 28° 58′ W., and the equator at 28° 22′ W.

This route leads through the same zones of winds as does that given for the month of February; so to find out the chances of calms and the direction of the winds reference must be made to those instructions; the *only difference* is, that in March the NE. trade will be lost at 1° N. and about 28° 20′ W., and the SE. trades will be found at 0° 20′ or 0° 40′ S., in the same longitude.

In *April*, cross, successively, 30° N. at 43° 19′ W.; 25° N. at 38° 17′ W.; 20° N. at 35° 04′ W.; 15° N. at 33° 40′ W.; 10° N. at 31° 19′ W.; 5° N. at 29° 20′ W., and the equator at 30° 12′ W.

Leaving the United States, the course is first to the eastward, keeping to the northward of the parallel of 40° N., which should be crossed at 56° or 57° W. From there a good course may be made, with winds predominating from SW., to cross 35° N. at 45° W. (better to the eastward than to the westward of this meridian). After having crossed 35° N. there will be 6 per cent. of calms, with winds predominating from ENE., SSE., and SSW., and occasional breezes from WSW. and NNW.; 30° N. should be crossed, as has already been said, at 43° 19′ W.

Between 30° and 25° N. there will be 13 per cent. of calms, with winds exceedingly variable, although rather predominating from NNE., ENE., and ESE. These winds turn into the trades at or about 27° 30′ N. Between 25° and 20° N. there will be 6 per cent. of calms, with winds from ENE., but sometimes varying to ESE. Between 20° and 10° N. the winds blow as often from E. as from NE. Between 10° and 5° N.

there will be 15 per cent. of calms, with winds predominating from NE. Between 5° N. and the equator there will still be the same number of chances of calms, and in this month the NE. winds do not cease blowing until about 1° N. and 30° W. is reached. The SE. trades will not be found higher than 1° 30′ S. at 30° or 31° W.

In *May*, the following crossings should be made, viz: 30° N. at 40° 51′ W.; 25° N. at 39° 10′ W.; 20° N. at 37° 18′ W.; 15° N. at 35° 15′ W.; 10° N. at 32° 46′ W.; 5° N. at 29° 56′ W., and the line at 30° 53′ W.

From the United States to the parallel 30° N. the route is the same at that given for the month of April. From New York to 5° N. the chances of calms and the directions of the winds are also the same, the two routes being very close together. In this month the NE. trades will be lost at 3° N. and 30° W., and those from SE. will be found at 2° N., on the same meridian of 30° W.

In *June*, cross 30° N. at 43° 33′ W.; 25° N. at 40° 16′ W.; 20° N. at 39° 12′ W.; 15° N. at 37° 35′ W.; 10° N. at 33° 12′ W.; 5° N. at 28° 16′ W., and the line at 31° 08′ W.

Leaving New York, the route to the parallel of 30° N. is the same as that given for the month of April. From 30° to 25° N. there will be 13 per cent. of calms, with winds predominating from ENE. and ESE., varying at times to NNE. or SSE., and occasional winds from WNW. to WSW. Between 25° and 20° N. there will be 8 per cent. of calms, with ENE. winds, varying sometimes to NNE., ESE., and SSW. From 20° to 15° N. there will be 55 per cent. of E. winds, and 45 per cent. from NNE. From 15° N. to 10° N. the winds will be from E. and NE. In June the NE. trades will be lost at 8° N. and 29° or 29° 30′ W.; and those from SE. will be found at 4° 30′ N. and 29° 30′ W. The chances of calms, between 10° and 5° N., are 18 per cent. to the westward of 30° W., and 9 per cent. to the eastward of that meridian; between 5° N. and the equator, on the contrary, there are 10 per cent. to the westward, and 19 per cent. to the eastward of 30° W.

In *July*, cross 40° N. at 57° 30′ W.; 37° 30′ N. at 52° 30′ W.; 32° 30′ N. at 47° 30′ W.; 30° N. at 45° 03′ W.; 25° N. at 42° 18′ W.; 20° N. at 39° 58′ W.; 15° N. at 37° 15′ W.; 10° N. at 34° 03′ W.; 5° N. at 28° 18′ W., and the equator at 31° 16′ W.

Leaving New York the course should be made to the eastward, finding 7 per cent. of calms, with westerly winds, keeping to the westward of the parallel of 40° N., which should not be crossed before 57° 30′ W. is reached. Then making the points of crossing already given, winds will be found, when between the parallels of 40° and 35° N., predominating from SW. and SSW., with which a good course may be made on the starboard tack. Throughout the whole of the first part of this course, care should be taken to guard against cyclones.

These storms are foretold by the aspect of the weather and sea, and particularly by a rapid fall of the barometer to .78 or .98 inch below the mean height, as also by the order in which the wind veers or hauls.

The direction in which the center moves varies from ENE. to NNE. *At all times, when facing the direction from which the winds blow, the center will be eight* (8) *points to the right.* When the wind blows between ESE. and SSE. and the barometer falls rapidly, a vessel may know she is on the track of the center of the storm; that is to say, in the very worst possible position; it will then be necessary either to run, with the wind quartering, heading N., or else take the starboard tack. After the center of the cyclone shall have passed the vessel, supposing it to have been impossible to avoid it, the wind will come out suddenly and violently from WNW. or NNE.; in this way, provided the precaution has been taken, as advised, of lying to on the starboard tack, the danger of being caught aback is lessened very much, with a corresponding decrease of danger to the masts. When a vessel is on the track of the cyclone the barometer generally falls from .01 to .03 inch per hour, with the center 300 miles distant; from .03 to .05 inch per hour with the center about 150 miles away, and the rate may attain .09 inch when the center is 75 miles distant.

Returning to our instructions for the route, whose points of crossing were given at the beginning, we will say that between 35° and 30° N. the winds will often be forward of the beam, or even ahead, when referred to the course, varying from ESE. to SSE. and SSW. Between 30° and 25° N. there will be 12 per cent. of calms, with the winds predominating from ENE., and variable to ESE.; as a general thing the NE. trades will be found at 27° 30′ N. and 42° 30′ or 43° W. Between 25° and 20° N. the trades will be well established, blowing from ENE.; from 20° to 15° N. the winds will predominate from ENE. after hauling to NNE. From 15° to 10° N. there will be 8 per cent. of calms, with winds prevailing from NE. and E., and a few occasional SE. and SW. breezes. In July the trades, that is, the winds from E. to NE., will be lost after 9° 30′ N. has been passed. A zone will be then entered containing 15 per cent. of calms; 25 per cent. of SE.; 25 per cent. of SW.; 25 per cent. of W.; 5 per cent. of E., and 5 per cent. of NE. winds; we may say, then, that there will be 50 per cent. of chances in favor of having to take the starboard tack with westerly winds, and 35 per cent. in favor of being forced to run on the port with easterly winds.

If vessels are forced to the eastward of the meridian of 30° W. when to the northward of 5° N. they will find but 8 per cent. of calms, 50 per cent. of S. winds, and 42 per cent. of those from SW. Finally, when to the southward of 5° N., no further fear of calms need be entertained; as to the eastward of 30° W. there will be about 48 per cent. of S. and 42 per cent. of SE. winds; and to the westward of this meridian the SE. winds are constant. In July, the SE. trades will be found well established from the parallel of 2° 30′ N.

In *August*, cross successively the parallels of 40° N. at 57° 30′ W.; 37° 30′ N. at 52° 30′ W.; 32° 30′ N. at 46° 30′ W.; 30° N. at 44° 15′

W.; 25° N. at 41° 21′ W.; 20° N. at 39° 25′ W.; 15° N. at 37° 02′ W.; 10° N. at 33° 54′ W.; 5° N. at 27° 28′ W., and the line at 29° 46′ W.

This route is almost the same as that for the month of July. The chances of winds and calms being the same, reference need only be made to the instructions for that month. We will add, the only difference necessary to be noticed is, that the NE. trades will be lost in August at 12° 20′ N., and those from SE. will be found about 3° 20′ N.

Cyclones are greatly to be feared in August, as this is the season of the year in which they are most frequent. A good watch should be kept on the barometer, and the instructions as given on this subject for July should be carried out.

In *September*, cross 40° N. at 57° 30′ W.; 37° 30′ N. at 52° 30′ W.; 35° N. at 48° W.; 30° N. at 41° W.; 25° N. at 38° W.; 20° N. at 35° 46′ W.; 15° N. at 34° 45′ W.; 10° N. at 32° 31′ W.; 5° N. at 28° 49′ W., and the equator at 30° W.

Leaving New York, easting should be made, finding 7 per cent. of calms with generally westerly winds, so long as the course is to the northward of the parallel of 40° N., which should not be crossed until 57° 30′ W. is reached. Then passing the crossings we have indicated, the winds will be found, when between the parallels of 40° and 35° N., predominating from SW. and SSW., and with them a good course may be made on the starboard tack. In this first part of the route a bright lookout should be kept for cyclones, as they are almost as frequent as in the month of August. We have given, for the month of July, the instructions necessary for such cases.

Between 35° and 32° 30′ N., which last should be crossed at 45° W., there will be 5 per cent. of calms, with the winds slightly ahead, when referred to the route; they will vary, however, from ESE. to SSE. and SSW. Between 32° 30′ and 30° N., 9 per cent. of calms and winds, predominating from E., SSE., and SSW., and occasionally from NNW. and NNE., may be expected. From 30° to 25° N. the prevailing winds are those from NNE., ENE., and ESE., and rather often from SSW. The hope may be entertained of finding easterly winds, that is, the so-called NE. trades, about 27° 30′ N. From 25° to 20° N. there will be 5 per cent. of calms and 95 per cent. of ENE. winds. From 20° to 15° N. the trades usually vary from NNE. to ENE. and E. From 15° to 10° N. there will be 8 per cent. of calms, with the winds predominating from E. and NE., interrupted by a few occasional SE. and SW. breezes. In this month the NE. trades will be lost about 12° N.

After passing 12° N., a zone will be entered which contains 15 per cent. of calms, with 25 per cent. of SE., 25 per cent. of SW., 25 per cent. of W., 5 per cent. of E., and 5 per cent. of NE. winds. This will give 50 per cent. of chances favorable to taking the starboard with westerly, and 35 per cent. of chances for taking the port tack with easterly winds.

To the eastward of the meridian of 30° W. and to the northward of 5° N., there will be but 8 per cent. of calms, 50 per cent. of southerly,

and 42 per cent. of SW. winds. Finally, between 5° N. and the line, no further fear of calms need be entertained; while to the eastward of the meridian of 30° W., there will be about 48 per cent. of S. and 42 per cent. of SE. winds; and to the westward of 30° W., the SE. winds will be found to be permanently established. The SE. trades will generally be found at or about 1° 45′ N.

In *October*, cross 40° N. at 59° W.; 37° 30′ N. at 52° 30′ W.; 35° N. at 45° W.; 30° N. at 41° 46′ W.; 25° N. at 37° W.; 20° N. at 34° 50′ W.; 15° N. at 33° 41′ W.; 10° N. at 32° 06′ W.; 5° N. at 29° 25′ W.; and the line at 30° 40′ W.

Following this route, the winds will nearly always be favorable from New York to 35° N.

During this month, also, a lookout should be kept for cyclones, although they are less frequent than in August and September. Reference may be made to what has already been said about cyclones when describing the route from New York to the line during the month of July.

Between the parallels of 35° and 30° N. the predominating winds are those from SSE. and ESE., varying at times to ENE. and NNE. Between 30° and 25° N., the prevailing winds are from NNE., ENE., ESE., and rather often SSW.; and the zone of trades will be entered about 25° 30′ N. Between 25° and 20° N. there will be about 7 per cent. of calms, with winds predominating from ENE., but variable to NNE. and ESE. From 20° to 15° N. the trades will be well established at ENE., but variable to ESE. Between 15° and 10° N. there will be 7 per cent. of calms, with winds from due E. Between 10° and 3° N. there will be from 15 to 16 per cent. of calms, with easterly breezes, varying, however, to NE. and SE.; and to the eastward of 30° W. there may be a few southerly winds. After passing 3° N. in November, there will be but 6 or 7 per cent. of calms, and the SE. trades will be found established at SE.

In *November*, cross 40° N. at 59° W.; 37° 30′ N. at 52° 30′ W.; 35° N. at 49° W.; 30° N. at 44° 13′ W.; 25° N. at 39° 22′ W.; 20° N. at 35° 50′ W.; 15° N. at 34° 07′ W.; 10° N. at 32° 36′ W.; 5° N. at 30° 07′ W., and the line at 31° 11′ W.

At this time there need be no serious fears of cyclones. The winds will most always be favorable from New York to 35° N. Between 35° and 30° N. the most frequent winds are those from SSE., ESE., and ENE., with occasional breezes from NNW. and WSW. Between 30° and 25° N. the predominating winds are those from NNE., ENE., and ESE., while they occasionally are from SSW. and WNW. Between 25°, where the trades are first felt, and 20° N., which should be crossed at 35° 50′ W., there will be 8 per cent. of calms, with winds prevailing from ENE., and mixed with breezes from NNE. and ESE. Between 20° and 15° N. there will be 8 per cent. of calms, with winds predominating from E., but varying to NE. From 15° to 10° N. there will be 7 per

cent. of calms, with winds from due E. From 10° to 5° N. there will be 15 per cent. of calms and predominating E. winds, interrupted by breezes from NE. and SE.; from 5° N. to the line there will only be 7 per cent. of calms, and the E. wind will be replaced by a well-established one from SE. In this month the NE. trades will be lost about 6° N.; and those from SE. will be found at 3° or 3° 20′ N.

In *December* the same route is to be followed, with about the same chances of weather, as far as 30° N., which should be crossed at 44° 21′ W.

Then cross 25° N. at 39° 34′ W.; 20° N. at 38° 11′ W.; 15° N. at 35° 31′ W.; 10° N. at 33° 22′ W.; 5° N. at 30° 29′ W., and the line at 30° 51′ W.

The chances of weather are about the same as in November; the routes for these two months leading through the same zones. The only difference is, that in the December route the NE. trades are lost about 4° N., and those from SE. are found to the southward of 2° 20′ N.

Route from the line to New York.—In *January*, *February*, and *March*, the line should be crossed at 30° 10′ W., and then a good course may be made to the northward until the NE. trades are found to be well established. As a general thing, in the month of January, the SE. trades, varying to ESE., reach to 1° N., and those from NE. to about 2° N.; in February they reach to 0° 30′ S. and 1° 20′ N., respectively; in March those from SE. are lost about 0° 40′ S. and 30° 10′ W., and those from NE. are found at 0° 40′ N. on the same meridian. Between the equator and 5° N. there will always be 9 per cent. of calms, and 36 per cent. of ESE., and 54 per cent. of NE. winds. Beyond 5° N. the trades will be well established, and the following crossings may easily be made: 10° N. at 40° W.; and 20° N. at 58° W. From the latter point the winds will vary to NE., E., and SE., and there will be about 5 per cent. of calms up to 25° N., which should be crossed at 67° 30′ W. A course should then be made, with winds variable, but predominating from NE., SE. and SW., with 5 per cent. of calms, so as to cross 27° N. at 70° W. Variable winds, coming from all points of the compass, will then prevail as high as 30° N., which should be crossed at 71° W. The winds, then predominating from a westerly direction, will blow alternately from SSW., WSW., WNW., and NNW., permitting a course to be run which will cross 35° N. at 72° 30′ W. Beyond 35° N. and up to New York, the prevailing winds will be from NW., but rather frequently from SW., W., or N.

In this season, during the latter part of the voyage, the weather will be cold and dry, with revolving storms, which, near the Bermudas, commence with SW. winds, passing then to W. and NW., while on the coast of America they begin with NE. winds, and turn to NW. and W. These series of storms are separated by short spells of calms and easterly winds.

In *April*, *May*, and *June*, the line should usually be crossed at or

about 31° 10′ W.; 10° N. at 37° 30′ W.; 20° N. at 55° W.; 25° N. at 65° W.; 30° N. at 67° 30′ W., and from there the course should be for New York.

In April the SE. trades will be lost about 1° 45′ N. and 30° 20′ W., and those from NE. will be found (blowing from E. to NE.) at or about 0° 30′ N. and 32° W.

In May the SE. trades will be lost about 1° N. and 32° 25′ W., and those from NE. will be found at 2° 35′ N. and 33° W.

In June the SE. trades reach as high as 2° 40′ N. on 33° 10′ W.; and the NE. trades will be found about 2° 35′ N. on 33° W.

The line should always be crossed to the westward of 30° W., from which place to 5° N. about 10 per cent. of calms, with winds from SE., E., and NE., will be experienced. If the equator should be crossed to the eastward of 30° W., 19 per cent. of calms will be met with.

The parallel of 5° N. should be crossed about 35° W., if possible, because to the eastward of that meridian and between 5° and 10° N. 18 per cent. of calms, with winds from SE. varying to E. and NE., will be found; while to the westward in the same zone, there will only be 6 per cent. to be feared, and the winds are well established from NE.

Beyond 10° N. and up to 15° N., which should be crossed at 46° 10′ W., the winds will be from NE.; they then commence and continue to vary from NE. to E. and even SE. until 20° N. is crossed at 55° W. From this point to 25° N., which should be crossed at 65° W., they blow equally from NE., E., and SE. From 25° N. to 30° N. the winds will be the same, but interspersed with occasional breezes from W. and SW., and 6 per cent. of calms. From 30° to 35° N., which is to be crossed at 70° 10′ W., the winds will predominate from ESE., SSE., and SSW., interrupted at times by WSW. and WNW. breezes and 4½ per cent. of calms. From 35° N. to New York the winds are exceedingly variable but predominate from SSW. and W.

In *July*, *August*, and *September*, the crossing of the line varies according to the place from which vessels may sail, but a course should be made with the SE. trades, varying to S. in such a way as to cross the parallel of 5° N. at 27° 30′ W., which may be done without experiencing a single calm.

In July the SE. trades are replaced by winds from S. at or about 2° 30′ N.; in August at or about 2° 45′ N., and in September at 1° 50′ N. Between 5° and 10° N., there will only be 8 per cent. of calms, with the winds blowing from S. as often as from SW. 10° N. should be crossed at 30° W., and a course of about NW. should be made, with the winds predominating from E. and NE., intermixed with but 8 per cent. of calms, to cross 15° N. at 35° W. From 15° to 19° N., which should be crossed at 50° W., the trades will be well established, blowing first from ENE. to NNE., and then from E. to NE. After having passed, with these same NE. winds, varying at times to E., the parallel of 20° N. at 55° W., the winds will be found from NE. and E., varying to SE., with

which a course may be steered to cross 22° 30′ N. at 62° 30′ W., and 25° N. at 67° W. Beyond 25° N. there will be 8 per cent. of calms, with winds from E. and SE., varying at times to NE. and SW.; 30° N. should then be crossed at 70° W., and a course steered for New York, with winds extremely variable, although predominating from SW.

If this route is not followed, and if vessels run to the northward too soon, they risk a very long stay in a zone where the chances of calms range from 8 to 17 per cent. This zone comprises all that part of the ocean between the Bermudas and the meridian of 55° W., as also to the southward of the Bermudas between 25° and 30° N. and to the meridian of 50° W.

If forced to pass to the northward of the Bermudas, frequent squalls and short storms may be expected; and as a general thing, particularly in July, sudden and violent gales may be looked for while in the vicinity of those islands.

No matter which route is chosen, care must always be taken to guard against cyclones, which are frequent at this season, but particularly in August and September. The weather and the barometer should be carefully watched, especially between the meridian of 46° or 48° W. and New York. Between 25° and 30° N. revolving storms travel to the NNW.; from 30° to 33° N. they travel N., and finally, beyond 33° N., they trend off, first to NNE. and then to NE. When in the trades, where the level of the barometer is almost stationary in ordinary times, a fall of .19 to .31 inch below the mean should be sufficient to attract attention; and a fall of .47 or .59 inch shows that the storm is but a short distance off. A fall of .59 to .78 inch will generally find three reefs in the top-sails, while with one of .98 inch the vessel will be lying to. At the center of the cyclone the barometer may fall from 1.5 to 1.78 inches. When *beyond* the zone of the trades, the fall of the barometer, under corresponding circumstances, will be from .19 to .39 inch greater, and particularly at the beginning of the bad weather.

Further, if strong easterly winds are felt between 25° and 33° N., or if after having passed 33° N. the winds are *very* heavy from SE., and at *the same time* there is a fall of .01 inch per hour of the barometer, there need be no doubt at all that the center of the storm is but about 300 miles distant, and that the vessel is directly in its track; with a fall of .03 to .05 inch per hour, the center will be 150 miles distant; finally, the barometer may fall at the rate of .07 to .09 inch per hour. With these indications a shift of wind from E. to W. may be looked for in the first position, and from SE. to NW. in the second.

In case when running, heading N. with SE.* winds, or heading NW. with E.† winds, it is found impossible to avoid the center of the storm,

* This refers to vessels to the northward of 33° N., where the wind at SE. will indicate that they are on the track of the cyclone.

† In the second case, between 30° and 33° N., easterly winds show that vessels are in the track of the center of the cyclone.

the vessels should be brought to the wind on the *starboard tack*, so as not to be caught aback in the shifts of wind.

In *October*, *November*, and *December*, the line should be crossed at 30° W., and a course made to the NNW. with the SE. trades, which will be lost; in October, at 3° N. and 31° W.; in November, at 3° 20′ N., and in December at 2° 30′ N. There will then be 7 per cent. of calms, with breezes from SE. and E., until the parallel of 5° N. is crossed at 31° 10′ W. The NE. trades may be looked for, in October, about 10° N.; in November, beyond 6° N., and in December, beyond 4° N. Between 5° and 10° N., all vessels should run to the N. or NNW., with 15 per cent. of calms, 17 per cent. of NE., 17 per cent. of SE., and 51 per cent. of E. winds. Beyond 10° N. the trades will be well established from due E. with 7 to 9 per cent. of calms; extending to 14° 30′ N., which should be crossed at 40° W. The winds continue blowing from due E., with 6 per cent. of calms, up to 17° 30′ N., which should be crossed at 45° 10′ W. The winds will then commence to haul to NE., but there will be 6 per cent. of calms, up to 20° N., which should be crossed at 50° W. Then the course should cross 25° N. at 60° W.; 30 N. at 65 W.; 35° N. at about 69° W., and from there to New York. In following this course, which will be easy, the winds between 20° and 25° N. will predominate from NE., but varying to E. and SE. From 25° to 30° N. the winds predominate from NE. and SE., with occasional SW. and NW. breezes. From 30° to 35° N., there are 6 per cent. of calms, with the winds prevailing from SSW., WSW., and WNW., but blowing occasionally from NE. and ESE. From 35° N. to New York the winds are exceedingly variable. Although the winds predominate from NW., they will often blow from W., N., or NE.

The precautions to be taken in regard to cyclones, which we pointed out for July, August, and September, and especially for the last two months, should be repeated for the month of October. As was said before, the weather and the barometer should be watched with unceasing care, in October particularly, beyond the meridian of 48° W. Vessels should avoid passing to the northward of the Bermudas, as the weather is so much worse than to the southward.

Between 30° N. and New York, the fine weather often lasts through October, but rarely reaches into November. In December the weather will generally be cold and dry, but very heavy weather, as in January, February, and March, may be expected.

PART II.

GENERAL INSTRUCTIONS FOR THE NAVIGATION OF THE SOUTH ATLANTIC OCEAN.

GENERAL INSTRUCTIONS

FOR THE

NAVIGATION OF THE SOUTH ATLANTIC OCEAN.

CHAPTER IV.

CALMS—WINDS—BAROMETER—CURRENTS—ICEBERGS.

Zones of calms. Equatorial and tropical calms.—At the beginning of the instructions for the navigation of the North Atlantic Ocean we explained, and we shall repeat it here, that the same number of chances of light airs or "cat's-paws" may be expected as of dead calms. This should be kept in mind when consulting the following table, in which there will be found for each season of the year the per centum of chances of calms, or the number of times in one hundred observations that calms have been found in the different parts of the South Atlantic Ocean. These tables are deduced from the English Admiralty Pilot Charts.

A close examination of this table will show that, with the exception of the coast of Brazil between 20° and 40° S., there is no well-defined zone of calms in the South Atlantic Ocean. As for the region known as the tropical calm-belt, the truth is, it does not exist in a belt-like form along a parallel at all. Between the parallels of 30° and 35° S., from October to March, and 25° and 30° S. from April to September, there is a series of calms, which may be called tropical calms, but they are the only evidence of that belt about the tropics whose existence is absolutely necessary to some authors in order that they may establish their theory of the circulation of the winds. But these parallels, on which there prevails at least 80 per cent. of good winds, cannot be considered as zones of persistent calms; they should only be taken into consideration in navigation, so as to avoid trying to make to the eastward or westward in that latitude. The table will be the best guide for such a case.

Table indicating the per centum of chances of calms.

South latitudes.	Longitudes from meridian of Greenwich.																						
	90° to 85° W.	85° to 80° W.	80° to 75° W.	75° to 70° W.	70° to 65° W.	65° to 60° W.	60° to 55° W.	55° to 50° W.	50° to 45° W.	45° to 40° W.	40° to 35° W.	35° to 30° W.	30° to 25° W.	25° to 20° W.	20° to 15° W.	15° to 10° W.	10° to 5° W.	5° to 0° W.	0° to 5° E.	5° to 10° E.	10° to 15° E.	15° to 20° E.	20° to 25° E.
January, February, March:																							
From 0° to 5°	---	---	---	---	---	---	---	---	---	---	0	0	2	2	0	0	0	0	0	5	---	---	---
5° to 10°	---	---	---	---	---	---	---	---	---	---	---	0	2	2	0	0	0	0	0	0	0	---	---
10° to 15°	---	---	---	---	---	---	---	---	---	---	0	0	0	3	1	1	2	2	0	0	---	---	---
15° to 20°	---	---	---	---	---	---	---	---	---	---	5	5	3	0	1	1	2	2	3	0	---	---	---
20° to 25°	---	---	---	---	---	---	---	---	---	13	7	6	2	7	8	4	2	2	2	2	12	---	---
25° to 30°	---	---	---	---	---	---	---	---	24	8	7	7	6	2	3	3	2	2	2	2	3	---	---
30° to 35°	---	---	---	---	---	---	---	13	6	10	4	3	9	5	4	6	7	7	3	4	3	3	7
35° to 40°	---	---	---	---	---	---	4	3	4	2	4	0	3	4	4	6	3	3	3	5	3	3	3
40° to 45°	---	---	---	---	---	3	4	3	2	4	3	3	5	7	9	0	0	3	4	3	4	0	2
45° to 50°	---	---	---	---	---	3	3	3	2	3	7	---	---	---	---	---	---	---	---	5	---	0	2
50° to 55°	1	5	---	---	12	6	3	3	0	---	9	---	---	---	---	---	---	---	---	---	---	---	---
55° to 60°	0	0	4	6	3	5	0	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
April, May, June:																							
From 0° to 5°	---	---	---	---	---	---	---	---	---	---	4	8	3	3	2	2	0	0	5	14	---	---	---
5° to 10°	---	---	---	---	---	---	---	---	---	---	---	0	3	3	2	2	0	0	0	0	15	---	---
10° to 15°	---	---	---	---	---	---	---	---	---	---	0	0	0	0	0	0	2	2	0	0	0	---	---
15° to 20°	---	---	---	---	---	---	---	---	---	---	8	7	3	0	0	0	2	2	0	0	---	---	---
20° to 25°	---	---	---	---	---	---	---	---	---	13	5	5	5	6	0	0	5	5	2	2	0	---	---
25° to 30°	---	---	---	---	---	---	---	---	23	11	4	3	4	3	4	0	5	5	2	2	3	---	---
30° to 35°	---	---	---	---	---	---	---	15	7	4	3	5	3	0	0	0	2	5	5	0	3	6	4
35° to 40°	---	---	---	---	---	---	6	2	7	5	5	0	0	0	7	0	0	0	0	0	2	2	4
40° to 45°	---	---	---	---	---	4	3	4	8	3	3	---	---	---	0	0	0	0	0	0	0	0	3
45° to 50°	---	---	---	---	---	9	3	2	5	9	---	---	---	---	---	---	---	---	0	0	0	0	0
50° to 55°	2	4	3	---	0	3	1	3	11	---	---	---	---	---	---	---	---	---	---	---	---	---	---
55° to 60°	---	2	3	4	4	4	10	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
July, August, September:																							
From 0° to 5°	---	---	---	---	---	---	---	---	---	---	0	0	0	0	0	0	2	3	2	3	---	---	---
5° to 10°	---	---	---	---	---	---	---	---	---	---	---	0	0	0	0	0	0	1	0	0	0	---	---
10° to 15°	---	---	---	---	---	---	---	---	---	---	3	0	2	2	1	1	1	1	0	0	0	---	---
15° to 20°	---	---	---	---	---	---	---	---	---	---	4	5	2	3	1	1	1	1	0	0	---	---	---
20° to 25°	---	---	---	---	---	---	---	---	---	8	5	0	4	4	2	0	1	1	3	3	0	---	---
25° to 30°	---	---	---	---	---	---	---	---	15	8	2	2	4	2	4	5	1	1	3	3	2	---	---
30° to 35°	---	---	---	---	---	---	---	7	8	13	3	3	3	3	2	2	2	3	4	4	5	3	3
35° to 40°	---	---	---	---	---	---	0	1	4	3	2	0	3	3	2	2	4	2	2	5	4	4	3
40° to 45°	---	---	---	---	---	4	2	6	5	2	3	0	---	---	0	0	0	0	0	3	4	4	3
45° to 50°	---	---	---	---	---	3	2	4	4	0	---	---	---	---	---	---	---	---	0	0	0	0	0
50° to 55°	---	5	5	---	0	3	0	2	0	---	---	---	---	---	---	---	---	---	---	---	---	---	---
55° to 60°	---	5	5	5	3	3	0	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
October, November, December:																							
From 0° to 5°	---	---	---	---	---	---	---	---	---	---	0	0	0	0	0	0	0	0	8	0	---	---	---
5° to 10°	---	---	---	---	---	---	---	---	---	---	---	0	0	0	0	0	0	---	0	0	---	---	---
10° to 15°	---	---	---	---	---	---	---	---	---	---	1	0	1	0	0	0	0	0	0	0	0	---	---
15° to 20°	---	---	---	---	---	---	---	---	---	---	5	2	3	2	0	0	0	0	3	---	---	---	---
20° to 25°	---	---	---	---	---	---	---	---	---	10	7	2	2	4	7	5	2	2	1	1	---	---	---
25° to 30°	---	---	---	---	---	---	---	---	11	5	2	4	3	5	3	7	5	2	2	1	1	0	---
30° to 35°	---	---	---	---	---	---	---	11	4	4	3	2	3	4	3	7	5	2	2	6	4	3	3	7
35° to 40°	---	---	---	---	---	---	16	6	2	3	4	0	4	5	4	3	2	2	2	4	2	3	3	2
40° to 45°	---	---	---	---	---	8	7	5	2	2	3	0	0	0	0	0	0	0	0	0	0	0	0	6
45° to 50°	---	---	---	---	---	3	4	4	5	0	0	---	---	---	---	0	0	0	0	6	0	0	0	0
50° to 55°	1	2	3	---	10	3	5	3	0	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
55° to 60°	0	0	3	4	5	5	3	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Resuming, we will say, then, that the only zone where one may be exposed to calms while in the South Atlantic is bounded on the W. by that part of the coast of America lying between 20° and 40° S.; on the N. by the southern limit of the SE. trades; and on the S. by the parallel of 30° or 40° S., according to the season. Be it well understood that we are not speaking of the equatorial calms; they were fully dis-

cussed in the indications given for the navigation of the North Atlantic Ocean.

Southeast trade-winds.—We have already given, in the instructions for the navigation of the North Atlantic, the equatorial limits of the SE. trades at each season of the year, and we simply refer the reader to that article for exact information on the subject, limiting our remarks at present to the fact that they nearly always reach to the northward of the equator.

The following table indicates, for each season of the year, the western and southern limits of the trades. Thus it may be seen that the general SE. wind commences at quite a distance from the coast of Africa, near which the SW. monsoon, as well as the land-breezes, to be spoken of farther on, prevail. It will also be seen that the southern limit of the trades does not extend along any particular parallel, as is stated by many authors, but follows a very crooked line, which lies in a *general* direction of WNW. and ESE.:

Table showing the latitude of the eastern and southern S. E. trade-limits.

Limit for each season.	Longitude reckoned from Greenwich.								
	30° 00′ west.	25° 00′ west.	20° 00′ west.	15° 00′ west.	10° 00′ west.	5° 00′ west.	Meridian of Greenwich.	5° 00′ east.	10° 00′ east.
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
Jan., Feb., March:									
Lat. of eastern limit	.....	.....	.....	2 30 N.	0 00	2 20 S.	7 00 S.	10 15 S.	20 00 S.
Lat. of southern limit	19 00 S.	20 40 S.	23 50 S.	26 20 S.	28 15 S.	29 05 S.	29 50 S.	31 30 S.	32 10 S.
April, May, June:									
Lat. of eastern limit	.....	.....	.....	3 30 N.	2 00 N.	0 00	2 15 S.	5 00 S.	19 00 S.
Lat. of southern limit	21 35 S.	23 15 S.	23 50 S.	24 35 S.	26 15 S.	27 00 S.	28 30 S.	31 50 S.	33 40 S.
July, Aug., Sept.:									
Lat. of eastern limit	.....	.....	5 00 N.	3 00 N.	1 30 N.	1 00 S.	4 30 S.	9 00 S.	17 00 S.
Lat. of southern limit	20 40 S.	22 40 S.	23 15 S.	24 20 S.	27 20 S.	28 40 S.	29 10 S.	29 25 S.	30 30 S.
Oct., Nov., Dec.:									
Lat. of eastern limit	.....	.....	.....	3 00 N.	0 50 N.	1 20 S.	4 35 S.	11 30 S.	20 00 S.
Lat. of southern limit	16 10 S.	18 30 S.	30 35 S.	21 15 S.	24 30 S.	28 00 S.	28 40 S.	29 10 S.	30 40 S.

In our general instructions for the North Atlantic Ocean we spoke of the observations of Rear-Admiral Bourgois, on the rotation of winds, as experienced by vessels coming from Europe, when entering the NE. trades, and by others bound to Europe, when leaving that region and entering the general westerly wind zone. It was shown, by the researches of that officer, that with the first series of vessels, the winds almost always turned, without any interruption, from W. and NW. around to N. and NE.; that is, in a *direct* rotation, or like the hands of a watch; it was also shown, that with the second series of vessels, those bound to Europe, it was found that the winds hauled without interruption in precisely the same manner; that is, from northward and eastward to SE., SW., and W.

The works of Admiral Bourgois, on the South Atlantic Ocean, contain other important facts, which we proceed to set forth. Vessels

bound to the southward through the SE. trade-zone, when between 20° and 28° S. and the meridians of 21° and 40° W., will most always see the wind haul from SE. to NE. and NW., and then without interruption transform themselves into general westerly winds, thus veering contrary to the motion of the hands of a watch, or in an *inverse rotation*. In the same way, vessels standing to the northward, when about to enter the trade-zone, will find the winds veering, between 30° and 20° S. and 2° 20′ and 26° E., from NW. to W. and SW., and then, without any interruption from calms, merging into the SE. trade-winds. This is also an *inverse rotation*.

From this we see that the direct rotation of the winds, as observed at the polar limits of the NE. trades, is replaced by an inverse rotation at the polar limits of the SE. trades. And, further, this same difference is found to exist in regard to the movement of the general westerly winds of each hemisphere, being a direct rotation in the northern, and an inverse rotation in the southern.

Notwithstanding the small number of observations of calms, resulting from the examination of log-books of vessels which have crossed the equatorial calm-zone, we think it our duty to insist on the table given in preceding article, p 102, where for each season of the year the per centum of them is pointed out. In this way vessels may know precisely what to expect.

We should state, however, that the winds do not *always* blow from exactly SE. throughout the zone we have assigned to the SE. trades. For this reason we shall give for each season of the year the principal localities where variable winds, but at the same time from a general southeasterly direction, may be expected. It will be remarked that the squares in which we will give the régime of winds are, generally speaking, outside the limits indicated in the preceding table. This is but natural. As for the localities within the limits, and of which we do not speak, it must be understood that the SE. wind blows there to the exclusion of all others.

There will also be found, in the indications about to be given, the régime of winds in the vicinity of the coast of Brazil, and of the western limit of the SE. trades, which latter cannot be exactly defined.

In *January*, *February*, and *March*, between 0° and 5° S. and 0° and 10° W., there will be about 50 per cent. of SSE. and 50 per cent. of SSW. winds. The same holds good for 5° and 10° S. and 0° and 5° W.

Between 20° and 30° S. and 0° and 10° E., there will be 66 per cent. of SE. and 31.5 per cent. of S. winds, with 1.5 per cent. of calms.

Between 20° and 30° S. and 0° and 10° W., there will be 71 per cent. of SE., 14 per cent. of S., and 13.5 per cent. of E. winds, with 1.5 per cent. of calms.

Between 20° and 25° S. and 10° and 20° W., the winds will predominate from SE. and vary to E. and to S.

Between 20° and 25° S. and 20° and 25° W., the winds will vary from SE. to N., passing through E.

Between 20° and 25° S. and 25° and 30° W., the winds predominate from N. and from E.; rather frequent from NE. and SE.

Between 15° and 20° S. and 20° and 30° W., the prevailing winds blow from SE. and E., and sometimes from NE. and N.

Between 10° and 15° S. and 20° and 30° W., the winds blow 75 per cent. of the time from SE. and 25 per cent. from E.

Between 0° and 10° S. and 20° and 30° W., there are 14 or 15 per cent. of S. and 84 per cent. of SE. winds, with 2 per cent. of calms.

Between 0° and 5° S., and to the westward of 30° W., the wind is from SE., without any calms.

Between 5° and 10° S., and to the westward of 30° W., there are SE. winds, which haul to the eastward as Cape Saint Roque is approached.

Between 10° and 12° 30′ S. and 30° and 31° 15′ W., there are about 60 per cent. of SE. and 40 per cent. of E. winds; and by going a little to the westward of 31° 15′ W. the 40 per cent. becomes the chances of ENE. winds.

Between 12° 30′ and 17° 30′ S. and 30° and 31° 15′ W., there are about 50 per cent. of ESE. and 50 per cent. of ENE. winds; and by going to the westward of 31° 15′ W. the latter 50 per cent. changes to chances of winds from E.

Between 17° 30′ and 20° S., and from 30° W. to about 20 leagues off the coast, the winds blow about equally from NNE., E., and ESE.

Between 20° and 25° S. and 30° and 40° W., the prevailing winds are those from NE.

In *April*, *May*, and *June*, between 0° and 10° S. and 0° and 10° W., there are 45 per cent. of SSE., 32 per cent. of ESE., and 23 per cent. of SSW. winds.

Between 10° and 20° S. and 0° and 10° E., there are 71 per cent. of SE. and 29 per cent. of S. winds.

Between 20° and 30° S. and 0° and 10° E., there are 70 per cent. of SE., 28 per cent. of S. winds, and 2 per cent. of calms.

Between 30° and 35° S. and 15° E., and the coast of Africa, the prevailing winds are from ESE., but interspersed with breezes from SW. and WNW., and 6 per cent. of calms.

Between 30° and 35° S. and 15° and 10° E., the winds predominate from ESE., varying to SSE., with occasional NNW. breezes.

Between 30° and 35° S. and 10° and 5° E., the winds blow about 50 per cent. from SE., 26 per cent. from N., and 24 per cent. from WSW.

Between 20° and 25° S. and from 15° to 20° W., there are 41 per cent. of SW., 30 per cent. of S., and 26 per cent. of SE. winds.

Between 20° and 25° S. and 20° and 25° W., there are 50 per cent. of E., 30 per cent. of SE., and 20 per cent. of NE. winds.

Between 20° and 25° S. and 25° and 30° W., the prevailing winds

are from E. and SE., with occasional winds from N., NE., S., and SW.

Between 15° and 20° S. and 25° and 30° W., there are about 45 per cent. of SE., 35 per cent. of E., and 17 per cent. of NE. winds, as also 2 per cent. of calms.

Between 10° and 15° S. and 25° and 30° W., the SE. winds are interrupted by a few easterly breezes.

Between 0° and 5° S. and to the westward of 30° W., the winds blow from SE.

Between 5° and 10° S., and from 30° W. to the coast of America, the prevailing winds are from SE.; however, from 32° W. to 33° 20′ W. the winds blow about 40 per cent. from SSE., and 60 per cent. from SE.

Between 10° and 13° S. and 30° and 32° 30′ W., the winds are from due SE.; but to the westward of 32° 30′ W., and to about 20 leagues off the coast, the winds are generally from ESE., and occasionally from SSE.

Between 13° and 17° S. and 30° and 32° 30′ W., the winds predominate from SE., varying to the eastward when nearer the first; and from ESE., varying to ENE., when nearer the latter meridian. Between these same parallels, but to the westward of 32° 30′ W., the winds are variable between SE. and NE.

Between 17° and 20° S., and from 30° W. to within 20 leagues off shore, the prevailing winds are those from SE.; they are, however, variable from S. and N. when passing to the eastward.

Between 20° and 25° S. and from 30° to 40° W., the winds are extremely variable; but still they are oftener from E. than from W.

In *July*, *August*, and *September*, between 0° and 5° S. and 0° and 10° W., the winds blow exclusively from SSE. and SSW. in about equal proportions.

Between 5° and 10° S. and 0° and 5° E., there are 62 per cent. of S., and 38 per cent. of SE. winds.

Between 10° and 20° S. and 0° and 10° E., there are 71 per cent. of SE., 21 per cent. of S., and 8 per cent of SW. winds.

Between 20° and 30° S. and 0° and 10° E., there are 65 per cent. of SE., and 32 per cent. of S. winds, as also 25 to 30 per cent. of calms.

Between 20° and 25° S. and 10° and 15° W., there are 71 per cent. of SE. and 29 per cent. of NE. winds.

Between 20° and 25° S. and 15° and 20° W., there are about 62 per cent. of E., 24 per cent. of N., and 14 per cent. of SE. winds.

Between 20° and 25° S. and 20° and 25° W., there are 45 per cent. of SE., 22 per cent. of E., 17 per cent. of N., and 16 per cent. of NE. winds.

Between 20° and 25° S. and 25° and 30° W., there are 43 per cent. of E., 35 per cent. of SE., and 18 per cent. of NE. winds, besides 4 per cent. of calms.

Between 15° and 20° S. and 20 and 25° W., there are 54 per cent. of SE. and 43 per cent. of E. winds, with 3 per cent. of calms.

Between 15° and 20° S. and 25° and 30° W., there are 70 per cent. of SE. and 28 per cent. of E. winds, besides 2 per cent. of calms.

Between 0° and 10° S. and 20° and 30° W., there are 77 per cent. of SE. and 23 per cent. of S. winds.

Between 0° and 5° S., and from about 29° to 31° W., the wind is from S. by E. to SSE. Between the same parallels, and from 30° to 33° W., they are from SE.; from 33° to 35° W., the wind predominates from S. by E., but varies to ESE.; from 35° to 37° W. they are from SE.; and finally, from 37° to 39° W. they are from SE., but vary, at times, to the eastward.

Between 5° and 10° S., and from 30° W. to the coast of America, the winds blow from due SE.

Between 10° and 13° S., and from 30° to 32° 30′ W., they blow from SE.; and from 32° 30′ W. to the coast of America, they blow from SE., but vary, at times, to E.

Between 13° and 17° S., and from 30° W. to within 20 leagues off shore of the American coast, they blow from ESE.

Between 17° and 20° S., and from 29° to 32° 10′ W., the prevailing wind is from SE., variable to ENE.; between the same parallels, and from 32° 10′ to 35° W., the winds predominate from ESE., varying to ENE.; from 35° to 37° W. they predominate from SE. and vary to NE.; finally, to the westward of 37° W., the reigning winds are those from NE. and SE., but, at times, there are SW. breezes.

Between 20° and 25° S., and from 30° to 40° W., the winds are exceedingly variable. They predominate from SE., and only blow from an easterly direction from 30° to 35° W. They then predominate from NE., varying, however, to E. and SE. from 33° to 35° W.; finally, they predominate from NE., varying from N. to SE., and sometimes from SW., between 35° and 40° W.

In *October*, *November*, and *December*, between 0° and 5° S., and from 0° to 5° W., there are 55 per cent. of S. and 45 per cent. of SW. winds.

Between 5° and 10° S. and 0° and 10° W., there are about the same number of SW. as SE. winds in the western part of this space, and in the eastern part there are 65 per cent. of SE. and but 33 per cent. of SW. winds.

Between 5° and 10° S. and 0° and 5° E., there are 46 per cent. of SSW., 39 per cent. of SE., and 15 per cent. of W. winds.

Between 10° and 15° S. and 0° and 5° E., there are 63 per cent. of S. and 37 per cent. of SE. winds.

Between 15° and 20° S. and 0° and 5° E., the winds blow from SSE.

Between 20° and 30° S. and 0° and 10° E., there are 70 per cent. of SE. and 29 per cent. of S. winds, besides 1 per cent. of calms.

Between 25° and 30° S., and from 10° E. to 20 leagues off shore of the African coast, there are 43 per cent. of S., 25 per cent. of SW., 16 per cent. of SE., and 16 per cent. of W. winds.

Between 20° and 25° S. and from 10° to 15° W., there are about 71

per cent. of N. and 24 per cent. of NE. winds, besides 5 per cent. of calms.

Between 20° and 25° S. and from 15° to 20° W., there are 38 per cent. of NE., 30 per cent. of E., and 25 per cent. of SE. winds, and also 7 per cent. of calms.

Between 20° and 25° S. and 20° and 25° W., there are 41 per cent. of E., 31 per cent. of SE., and 24 per cent. of NE. winds, as also 4 per cent. of calms.

Between 20° and 25° S. and 25° and 30° W., there are 34 per cent. of E., 21 per cent. of N., 21 per cent. of NE., and 21 per cent. of SE. winds, and 3 per cent. of calms.

Between 15° and 20° S. and 20° and 25° W., there are 50 per cent. of SE. and 48 per cent. of E. winds, and 2 per cent. of calms.

Between 15° and 20° S. and 25° and 30° W., there are 38 per cent. of E., 37 per cent. of SE., and 22 per cent. of NE. winds, and 3 per cent. of calms.

Between 10° and 15° S. and 25° and 30° W., there are 71 per cent. of SE., and 27 per cent. of E. winds, besides 2 per cent. of calms.

Between 0° and 10° S., and to the eastward of 32° 30′ W., the winds blow from SE.; to the westward of 32° 30′ W. they blow about 60 per cent. of the time from SE. and 40 per cent. from E.

Between 10° and 13° 30′ S., and to the westward of 30° W., the wind blows from ESE. to ENE.

Between 13° 30′ and 17° 30′ S. and to the westward of 30° W., they blow from between SE. and NE.

Between 17° 30′ S. and 20° S. and from 29° to 31° W., the winds predominate from ESE. to ENE., although blowing at times from S. and from N.; from 31° to 33° W. they predominate from E., but vary to NE., and occasionally to NNW. and SSE.; from 33° to 35° W. they predominate from NE., and blow occasionally from ESE. or N.; from 35° to 37° W. they predominate from NE. and N., blowing occasionally from E.; from 37° W. to 20 leagues off shore, the prevailing are the NNE. winds, and the variable are those from SE. and ENE.

Between 20° and 25° S. and 29° and 33° W., the winds blow between SE. and ENE.; the same holds good for from 33° and 35° W., with a few chances of N. winds; from 35° to 37° W. they predominate from NE., blowing quite often from SE. and N., and sometimes from S.; from 37° to 40° they predominate from NNE., but blow occasionally from ENE., SE., SSW., and WSW.

Monsoon of the African coast.—A monsoon, *called the SW.*, although blowing oftener from SSE. and SSW. than from SW., prevails between the coast of Africa and the eastern limit of the SE. trade-winds, as given in the table (p. 103) of the preceding article. This monsoon lasts through the whole of the year. Nevertheless it is better established from April to September, when the sun has the greatest power in heating the whole of the central part of Africa, and makes it a center

of suction, as it were, which draws the SE. trades from their proper direction and causes them to haul to S. and SW. for a long distance off shore.

In the instructions for the North Atlantic Ocean, we described the régime of the monsoon of the African coast above the equator. It now remains for us to point out the prevailing winds below the line and in the squares comprised between the coast and the eastern limit of the SE. trades. The following remarks are extracted from the Pilot-Charts of the English Admiralty:

In *January*, *February*, and *March*, between 0° and 5° S., and from 0° to 5° W., the chances of SSE. and SSW. winds are about equal. Between the same parallels, and from 0° to 5° E., there are 46 per cent. of SSW., 27 per cent. of SSE., and 27 per cent. of WSW. winds; finally, from 5° E. to the African coast there are 34 per cent. of S., 20 per cent. of SE., 21 per cent. of SW., and 20 per cent. of westerly winds, with 5 per cent. of calms.

Between 5° and 10° S., and from 0° to 5° E., there are 71 per cent. of SSE. and 29 per cent. of SW. winds. Between the same parallels, and from 5° to 10° E., the winds blow constantly from S. From 10° E. to the coast of Africa there are 38 per cent. of S., 30 per cent. of SW., 16 per cent. of SE., and 16 per cent. of W. winds.

In *April*, *May*, and *June*, between 0° and 5° S., and from 0° to 5° E., there are 45 per cent. of S., 25 per cent. of SE., and 25 per cent. of SW. winds, with 5° per cent. of calms.

Between 0° and 5° S., and from 0° to 10° E., there are 32 per cent. of S., 15 per cent. of SE., 15 per cent. of ENE., and 24 per cent. of WSW. winds, with 14 per cent. of calms.

Between 5° and 10° S., and from 0° to 10° E., there are 48 per cent. of SE., 26 per cent. of S., and 26 per cent. of SW. winds.

Between 5° and 10° S., and to the eastward of 10° E., there are 36 per cent. of SSE., 35 per cent. of SW., and 14 per cent. of W. winds, with 15 per cent. of calms.

Between 10° and 15° S., and to the eastward of 10° E., there are 38 per cent. of S., 31 per cent. of SW., and 31 per cent. of W. winds.

In *July*, *August*, and *September*, between 0° and 5° S. and from 0° to 5° E., there are 60 per cent. of SW. and 37 per cent. of SSE. winds, with 3 per cent. of calms.

Between 0° and 5° S., from 5° to 10° E., there are 37 per cent. of S., 37 per cent. of SW., and 23 per cent. of W. winds, with 3 per cent. of calms.

Between 5° and 10° S., and from 5° to 10° E., there are 29 per cent. of S. and 71 per cent of SW. winds.

Between 5° and 10° S., and from 10° E. to the coast of Africa, there are 27 per cent. of SW., 31 per cent. of S., 21 per cent. of SE., and 21 per cent. of W. winds.

Between 10° and 15° S., and from 10° E. to the coast of Africa, the prevailing winds are from S. and SW., but varying to W.

In *October*, *November*, and *December*, between 0° and 5° S. and 0° and 5° E., there are 38 per cent. of S., 33 per cent. of SW., and 20 per cent. of W. winds, with 9 per cent. of calms.

Between 0° and 5° S., and from 5° to 10° E., there are 41 per cent. of S., 41 per cent. of SW., and 18 per cent. of W. winds.

Between 5° and 10° S., and from 5° to 10° E., there are 50 per cent. of S. and 50 per cent. of SW. winds.

Between 5° and 10° S., and from 10° E. to the coast of Africa, there are 45 per cent. of S. and 55 per cent. of WSW. winds.

Between 10° and 15° S., and from 5° to 10° E., there are 55 per cent. of S. and 45 per cent. of SW. winds.

Between 10° and 15° S., and from 10° E. to the coast of Africa, there are 81 per cent. of SW. and 19 per cent. of W. winds.

General westerly winds.—Vessels bound to the southward leaving the SE. trades, in the South Atlantic Ocean, enter a zone generally known by the name of the *region of variable winds*, in which the direction and force of the winds change in a very irregular manner. The equatorial limit of this zone oscillates toward the north from March to September, and toward the south from September to March, following the movement of the polar or southern limit of the SE. trade-zone, as given in remarks on the SE. trade winds.

However, the exact line of separation of the two zones can never be precisely known, for, as we have already said, when moving to the southward the winds will be found to haul from SE. to NE. and NW. without any interruption, and there become general westerly winds; while, when moving in the opposite direction, the general westerly winds will be found to haul to W., SW., and S., and then to merge into the SE. trades. From the moment that we prove that this shifting of the wind in an inverse rotation takes place, as it almost always does, without any well-marked transition, we see the impossibility of fixing *exactly* the commencement or end of either zone. This difficulty of fixing the zones becomes all the greater, since the region of SE. trades cannot be precisely defined; for these winds themselves are quite variable in their direction, particularly in the squares near their limit, as was before pointed out.

In this region of *variable winds*, we remark two principal currents of air. These are, on one side, the *polar* winds or currents, blowing from SW. and SE.; and on the other, the *tropical* winds or currents, coming from NE. and NW.

These currents often cross each other, and thereby frequently give rise to revolving movements in the atmosphere, analogous to those observed on the surface of water at the junction of two currents; at the confluence of two rivers, for example. The resultant of these polar and tropical currents is generally a westerly wind; from this it appears

more rational to change the name of this zone, the *variable wind-zone*, to the *general westerly wind-zone.*

When either of these currents of which we have spoken overpowers the other, there is observed a series of either polar or tropical winds, as the case may be. When both the currents, at the same time, acquire very great force, their meeting gives rise to turning movements of great violence in the atmosphere, which are known by the name of *cyclones*, or *revolving storms.*

Generally, the polar or southern winds are cold, dry, and squally, and the tropical or northern winds are warm, humid, and rainy. This fact, under many circumstances, permits a change of wind to be foretold. Thus, when the wind is NW. and a clear space is observed to form in the SW. or S., and at the same time the thermometer falls, and the deck, sails, cordage, &c., rapidly become dry, we may conclude that the wind will soon haul to the SW., and will blow from a southerly direction. These prognostications may be considered as certain if accompanied by a rise in the barometer.

Inversely, southerly, southeasterly, or easterly winds will soon haul to the northward; if the horizon becomes cloudy in that quarter, the weather becomes warmer, and the deck, sails, cordage, &c., are covered with dampness. These signs will be accompanied by a fall in the barometer.

It is thus seen that, in spite of their apparent inconstancy, the variable winds, in their many changes of direction, follow a very evident general law. They turn, on the compass, with the sun, or contrary to the motion of the hands of a watch; that is, they blow successively from N., NW., W., SW., S., and so on. When, by an exception, they do not follow this law in shifting, as, for example, when they haul from SW. to NW. and NNW., they are said to *back*, and bad weather may be expected; the horizon and the barometer should then be closely watched.

Another fact, equally important, and well known to mariners, is that the NW. and generally northerly winds never become violent until after blowing some time. While, on the contrary, the wind often hauls suddenly and without decreasing in violence from NW. to SW., so that bad weather from SW. often springs up in the southern hemisphere, the same way that bad weather from NW. does in the northern one. On this account, when vessels have heavy NW. weather in the southern hemisphere, they should take the *port* tack, so as to be ready for any sudden shift of the wind to SW. By taking the starboard tack they are exposed to be *taken aback*, and, possibly, *dismasted.*

Prevailing winds on the coasts of Africa and South America—local winds.—In *January*, *February*, and *March*, *along the coast of Africa* to the eastward of the Cape of Good Hope, and from that cape to 25° E., the prevailing winds are those from SE.; these are sometimes very violent, and are followed by light westerly breezes. A good lookout should be kept for westerly gales.

Off shore, the prevailing winds are those from WSW., varying from NW. to W., SW., and WSW.

On the coast from Good Hope to Cape Negro, well-established SSE. and SSW. winds predominate. Farther to the northward, near the tropics, land and sea breezes are found; but to the southward of the parallel of 23° or 24° the SSW. winds increase in force in proportion as the Cape of Good Hope is approached. There are no rains, but the dews are very heavy; at times fogs will be encountered, the land will be hazy in the morning, and gales of wind may be looked for at new and full moon.

This is the rainy season from Cape Negro to Cape Lopez. Tornadoes* from ESE. to S., and winds predominating from S. and SW. The month of March is stormy. This is also the rainy season on the coast of America, and off the Amazon and Maranham; NW. and SW. squalls.

Between 40° W. and Cape Saint Roque, the trades blow with force from ENE.

From Cape Saint Roque to Bahia, the trades blow from ESE.; light rains.

From Bahia to Rio de Janeiro, the prevailing winds are from NNE to E. At times there are squalls from N. and W., accompanied by thunder and rain. Calms and variable breezes are frequent in March.

From Rio de Janeiro to about 33° S., the prevailing winds blow from NNE. to ENE. If the winds become very strong, look out for a calm, and then a change to SW. Off Saint Catherines the weather is both squally and rainy.

At the mouth of the Plata the winds predominate from NE., and in the river from E.†

Off the east coast of Patagonia, from 40° to 51° S., the prevailing winds are from the westward, accompanied by clear weather. A look-out should be kept, particularly at new and full moon, for heavy SE. gales, which bring in rains, with cloudy weather and a heavy sea.

In the vicinity of the Falklands calms are rare. The gales begin at NW., and then haul to SW. Generally the wind is lighter at night than during the day.

Off Cape Horn, the months of January and February are the warmest. At that time gales from the westward, accompanied by rain, are frequent; these gales acquire their extreme violence about the time of the equinoxes. At this season very fine passages are made from east to west by going down to the parallel of 60° S. The southerly gales never change their direction in a sudden shift; while, on the contrary, those from NW. often shift to SW., and retain their full force.

In *April*, *May*, and *June*, along the coast of Africa, to the eastward of

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*These are much less violent in the southern hemisphere. At the Congo they become only very heavy rain-storms, without wind, forming at E. and ending at SW.

†At the end of this article there will be found a special note upon the *pamperos* and *suestadas* of the Rio de la Plata.

the Cape of Good Hope, and to the meridian of 25° E., the westerly winds commence in the month of May. This region is exposed to gales which blow alternately from the eastward and from the westward.

Off shore the winds are generally from WSW., varying to NW., W., SW., and WSW.

On the coast, from 28° to 17° S., SSW. winds prevail, bringing heavy dews and fogs. Then follow NW. winds, with tide-rips. Gales are to be feared at new and full moon. The land is hazy in the mornings.

From 13° to 3° S. is the region of the SW. monsoons. Smoky fogs accompany the southerly winds during the month of June.

Along the American coast, and off the Amazon, the change of season takes place in the month of May, and is accompanied by rains and variable winds. Calms and squalls are frequent.

Between 45° W. and Cape Saint Roque, as well as off the Maranham, there is fine weather in June, with winds from ESE.

From Saint Roque to Bahia this is the rainy season. The trades often haul to SSW., with rain and squalls.

From Bahia to Rio de Janeiro this is also the rainy season. The prevailing winds are from SE. to E., light and variable. There are, at times, SW. winds, with squalls and rain, and NW. winds with thunderstorms.

From Rio de Janeiro to Saint Catherines, gales from SE. and SW. may be expected.

From Saint Catherines to about 34° S. the winds are from NE. in April, and followed by winds from SW.

Off the mouth of the river La Plata there are generally W. and SW. winds. The southerly winds are squally.

On the coast of Patagonia, from 40° S. to the Straits of Magellan, the prevailing winds are from the westward, with fine weather. However, in May and June, the winds are often from the southward. SE. gales are frequent at full and new moon, and are accompanied by cloudy, rainy weather, and a very heavy sea.

In the vicinity of the Falkland Islands, this is the best season of the year. The WNW. and WSW. winds are often replaced by easterly breezes.

Off Cape Horn, violent gales from NW. and SW. are frequent toward the middle of May, followed by moderate weather, and a few chances of easterly winds. This season is the best for doubling the cape, when bound to the westward, by passing in sight of the Diego Ramiraz Islands. Southerly gales never shift very suddenly, as do those from NW., which frequently haul to SW. in a squall, and continue to blow with the same strength.

In *July*, *August*, and *September*, along the coast of Africa, to the eastward of Good Hope, and as far as 25° E., the prevailing winds are westerly. At this season, there are very heavy gales commencing at W. or NW. and turning to SW.

On the coast, from 16° to 28° S., northerly winds are frequent and follow violent tide-rips, until toward the end of August. There are then SSW. winds, accompanied at times by thick fogs and great humidity. Look out for gales at new and full moon.

From the equator to about 16° S., during the months of July and August, there are, as in June, a sort of smoky fogs, which accompany the light winds prevailing from the southward, but which sometimes blow from seaward. In September the winds become stronger and bring in rain, which falls in light showers; there is a land-breeze in the morning.

On the American coast, from the Amazon to Cape Saint Roque, the winds are well established, and blow from ESE., with very fine weather.

From Saint Roque to Bahia the change of season takes place in September. The trades, accompanied by squalls, are well established from the southward.

From Bahia to Rio de Janeiro the prevailing winds are from SE., turning at times to SW., and blowing with great force. Standing off shore, there are light and variable winds, accompanied by SW. to NW. squalls, with thunder and rain. In September light breezes from E. to S.

From Rio de Janeiro to the Plata the winds are SW., with gales from SE. to SW. The winds are equally frequent from NE. Westerly winds are rare; they are ordinarily accompanied by bad or *dirty* weather.

The locality of the Plata River, between the parallels of 31° and 40° S., and off shore to the meridian of 48° W., is exposed to violent gales called *pamperos*.* Bad weather, particularly at the end of August. Fogs at the entrance of the river.

On the coast of Patagonia, from 40° to 50° S., during this season, there are generally westerly winds and fine weather. The southerly winds are more frequent at this season than in summer. Easterly winds bring in rain. Fogs are often met with.

About the Falkland Islands there are occasional gales from the eastward in July. The gales from S. and SE. are more persistent than those from SW.

Off Cape Horn the worst weather happens in August and September. About the equinoxes there are violent gales of wind. Those from the westward are accompanied by snow and sleet. At this season, good passages may be made from east to west, by running down to 60° S. The southerly gales never shift suddenly, as do those from NW., which frequently haul to SW. in a squall, and continue with the same force.

In *October*, *November*, and *December*, along the African coast, to the eastward of Good Hope, and to the meridian of 25° E., there are occasional gales from the westward; the weather is generally fine. The SE. gales often attain the force of tempests. *Off shore*, the prevailing winds are from WSW., varying, however, to NW. and SW.

* See the end of this article for a description of *pamperos* and *suestadas* of the Plata.

On the coast, from 18° to 30° S., well-established SSW. winds prevail. Farther to the northward there are land and sea breezes; but to the southward of 23° or 24° S. the SSW. winds increase in force in proportion as the Cape of Good Hope is approached. There are no rains, but the dew is very heavy at night; at times there are fogs; the land is hazy during the morning; and, finally, gales may be expected at new and full moon.

From Cape Negro to Cape Lopez, that, is between 2° and 15° S., the winds are from SW. in October, and followed by variable winds and very uncertain weather. Tornadoes* from S. to SE.

On the coast of America, off the Amazon, and from Cayenne to Maranham, the change of wind from ESE. to NE. takes place in November. At this time the weather is much finer than in the month of May, in which the opposite change takes place.

From Maranham to Cape Saint Roque the rains commence in December.

From Saint Roque to Bahia the winds are from ESE., with a few northerly and westerly squalls.

From Bahia to Rio de Janeiro, or even to the parallel of 21° 30′ S., this is the dry season. The winds predominate from NNE., and blow tolerably strong in December.

On the parallels of 22° to 23° S., in October, there are frequent northerly and westerly squalls.

From Rio de Janeiro to the mouth of the Plata the winds are (in November and December) from NNE. to ENE. If they become very strong, they will soon be replaced by calms and then SW. winds. Off Saint Catherines, there are squalls and rain.

In the Plata River, the winds are E. and SE. during the day, and NNW. at night. A little off shore they are from NE.

From the Plata to 50° S., on the coast of Patagonia, the prevailing winds are westerly, and the weather is very fine; gales from SE. are frequent toward new and full moon, and are accompanied by overcast weather and a heavy sea.

About the Falklands, gales of wind are frequent. They commence blowing from NW., and then turn to SW. They are lighter at night than during the day. The month of October is very stormy.

Off Cape Horn, the month of October is stormy; November and December are more pleasant, but rainy. The southerly gales never change their direction very suddenly, as do those from NW., which frequently shift to SW. in a squall, and continue to blow with the same force.

The pamperos and suestadas of the Plata River.—We have already said that the months of July, August, and September were the

* We refer the reader to what was said about tornadoes in the instructions for the North Atlantic. To the southward of the equator the tornadoes are much less violent. To the southward of the Congo they are no more than heavy rain-storms, without wind, which form in the E. and pass to SW., where they end.

seasons of *pamperos* and *suestadas* in the neighborhood of the Plata River. The name of *pampero* is, on the coast of Brazil, given to SW. gales of wind; and that of *suestadas* serves to denote gales from SE. in the same locality. Thus, as was said before, *pamperos* may be felt as far off shore as the meridian of 48° W., and along shore from 40° to 31° S., or even to Saint Catherines (27° 30′ S.). We proceed to give some remarks on the gales on the coast of Brazil, taken from the *Manuel de la Navigation dans la Plata*, by Commander Mouchez:

In the Plata the SW. winds, either strong or light, are known by the name of *pamperos*, on account of the pampas over which they travel before reaching the coast. They may be divided into two classes, the *local* and the *general* pamperos. The first class are of short duration, and even when they attain great force the weather remains clear; the other class, on the contrary, are accompanied by rain and thunder storms They descend from the chain of the Andes, and form the heavy tempests of the Plata. These are properly the gales to which mariners give the name of *pampero*; they generally last for three days. The following are the different circumstances or signs which, either together or separately, nearly always precede a pampero:

An interruption of the regular rotation of day and night breezes; a series of northerly winds, which are exceedingly warm, and occasion a suffocating atmosphere; fresh NE. winds, following uncertain weather; then winds from N., freshening and hauling to NW., with haze or light rain; if, in this case, the horizon is cloudy to the SW., and there are several clear spots seen also in that direction, the pampero is certain; a great fall of the *barometer*, which precedes the bad weather by several hours, and sometimes whole days; an elevation in the waters of the stream; the presence in the atmosphere of myriads of insects and small silken-like threads, somewhat like spider web; finally an extreme transparency of the atmosphere, and a mirage which permits the San Juan Hills, at Buenos Ayres, to be seen.

From the instant the pampero begins the weather becomes colder to a degree which is really uncomfortable. Its duration, in winter, is from two to three days, rarely from five to six. In summer they are less frequent and of shorter duration than in winter, but they blow with greater violence. They are then called *turbonadas*, because after several hours they haul to S. and SE., losing nearly all their force. There is a tradition in the Plata that there is always a heavy gale of wind on the feast-day of Santa Rosa (end of August). These gales are almost as regular in their arrival as are the equinoxes on the coast of Bretagne, in France.

The *suestadas*, or SE. gales, are the most to be feared of any at the mouth of the Plata, because they blow directly on to a coast devoid of shelter, and are accompanied by rains and fogs, which completely obscure the land. Besides that, they give rise to strong currents setting north along the coast, and raise a very heavy sea on the edge of soundings. These gales are foretold by a very great rise in the barometer, by weather which is cloudy, threatening, and accompanied by lightning: then the sky is red at sunrise, the waters are very high, and a strong current sets up the river, particularly outside of the Ortiz Bank.

South Atlantic currents.—*Equatorial current:* We have already, in the general instructions for the North Atlantic Ocean, given a description of the equatorial current, and we would now refer the reader to that article; he will there find the indications of its northern limit as well as its velocity above the equator. We shall complete those remarks by the few following lines:

The equatorial current is felt below the equator as far as the parallel of 10° S. It sets to the westward with a velocity of 18 to 36 miles per day, at the meridian of 5° E. On the meridian of Greenwich, and be-

tween 0° and 5° S., it varies from 12 to 30 miles per day; and between 5° and 10° S., it varies from 12 to 24 miles per day. At the meridian of 2° 30′ W., and between 0° and 5° S., it varies from 16 to 48 miles, and between 5° and 10° S. from 6 to 12 miles per day. On 5° 30′ W., and between 0° and 5° S., the velocity is from 12 to 36 miles, and from 5° to 10° S. about 12 miles per day. At 11° W. and between 0° and 5° S. the velocity is from 12 to 50 miles, and between 5° and 10° S. it is from 12 to 30 miles per day. At 16° W. the velocity varies from 14 to 33 miles per day between 0° and 5° S.; and from 12 to 30 miles between 5° and 10° S. On the meridian of 20° W. the velocity varies from 20 to 45 miles when between 0° and 5° S.; and attains about 18 miles between 5° and 10° S. At 25° W. and between 0° and 5° S., the westerly current varies from 12 to 67 miles; and between 5° and 10° S., from 12 to 24 miles per day.

Between 25° and 30° W. the velocity of the westerly current, between 0° and 6° S., varies from 12 to 51 miles; the maximum velocity (24 to 51 miles) is attained between the parallel of 3° 50′ and 5° S. Below the parallel of 6° S., and to the westward of the meridian of 25° W., to within 25 leagues of the coast, the waters begin to trend to WSW. and SW. The velocity of this current varies from 12 to 36 miles, setting SW. when between 6° and 10° S., and from 25° W. to within 25 leagues of the coast. A counter-current setting north, with a velocity of about 12 miles, follows the coast line and extends 20 or 25 leagues to seaward. This counter-current begins about 12° S., setting first NNE., then N., turning Cape Saint Roque, setting to the NW., and mingling its waters with those of the equatorial current.

About Cape Saint Roque, and near the land, between 35° and 40° W., the strongest currents are observed from March to September; velocity from 20 to 60 miles per day. In the other quarter, from October to February, the velocity is only from 12 to 18 miles per day.

Between the line and 5° S., on the meridian of 30° W., the velocity of the equatorial current setting to the westward is from 20 to 48 miles per day; on the meridian of 32° 30′ W., it varies from 25 to 40 miles; and on 35° W., from 20 to 60 miles per day. On this last meridian the velocity augments, from the line to Cape Saint Roque, where it attains its maximum. Between 37° and 38° W., and from the line to 2° S., the velocity is from 10 to 24 miles, and the set to the WNW.; from 2° to 4° S. it varies from 20 to 58 miles; and finally, near the land, it is about 30 miles per day. On the meridian of 40° W., between the line and the coast, the velocity of the WNW. current varies from 25 to 82 miles per day. On 42° W., between the line and the coast, the velocity to the westward is from 18 to 30 miles per day.

Brazil current: We have already pointed out that, to the southward of 6° S., and from 25° W. to within 25 leagues of the coast, the current begins to trend to the WSW. and SW. This WSW. and SW. movement of the surface waters constitute what is known as the *Brazil* cur-

rent, which exists from 6° or 7° to 30° S., with a breadth of about 200 leagues of longitude in the zone between 50 and 250 leagues off the Brazilian coast.

On the parallel of 10° S. the velocity of the current setting SW. varies from 12 to 24 miles per day. On 13° S., velocity from 12 to 44 miles, and set WSW.; between 15° and 16° S., velocity from 12 to 66 miles, set WSW.; at 18° S., the velocity varies from 18 to 30 miles; at 20° S. it is from 12 to 18 miles per day. At 23° S. the velocity is about 30 miles, setting SSW.; this is at 80 leagues off shore, while at 150 or 200 leagues off shore the velocity varies from 12 to 18 miles, setting to W. and WSW. At 25° S. the velocity of the current setting SW. varies from 18 to 42 miles; and between 25° and 30° S. the velocity is not more than a dozen miles per day, setting to the S. or SSW.

Counter-current of Brazil: Between 10° and 23° S., along the coast and for 50 leagues seaward, there are currents varying according to the direction of the winds. Generally, from October to January, the current in this zone is found to set SW., with a velocity of 25 or 30 miles per day. On the contrary, from March to September, there is a northerly current, whose maximum velocity, 48 miles per day, is attained in July.

From Cape Frio to the island of Saint Catherines, there is at times a counter-current along the shore setting NE.

From the island of Saint Catherines to Cape Santa Maria, just north of the Plata River, all along the shore for 50 leagues seaward, there is a current setting to the southward with the NE. winds, which sometimes reaches a velocity of 40 miles per day. But when the wind blows from SE. it throws the waters back on the coast and produces a very heavy sea.

Currents of the Plata: In the Rio de la Plata, the currents depend upon the winds. The waters rise with southerly and fall with northerly ones.

Off the mouth of the river the currents set to the NNW. with and during southerly winds; and they set to the SSE. just before and during the continuance of those from the northward; the velocities vary from 1 to 3 miles per hour.

We here quote the remarks of Rear-Admiral Cloué, of the French navy, upon the currents at the anchorage of Maldonada:

> During a "local" *pampero*, ridden out at this anchorage the 25th of September, 1868, by the frigate Astrée, the current was so strong as to prevent the ship from swinging to the SW. wind. She rode with her head WSW., even when the wind hauled to SSW. Although the sea was not very heavy the swell took the ship square abeam and caused her to roll considerably. In spite of this the roads of Maldonada may be regarded as a very good anchorage, the holding-ground being excellent.

From the mouth of the Plata and extending to about 38° W., there is a current of about 1 mile per hour, setting to the E. and ENE., which is supposed to be fed by the mass of water from the Plata River.

About abreast of the mouth of the Plata and between 32° and 45° S., there is generally observed, when running from east to west, a very sensible diminution of the temperature of the waters at the surface of the ocean, at a distance of about 40 leagues from the line of soundings.

Between the parallels of 38° and 44° S., and at a distance of from 70 to 90 leagues from the line of soundings, there are zones in which the temperature of the surface water is sensibly elevated above the neighboring waters.

Coast of Patagonia: On this coast, and between the parallels of 39° and 60° S., regular tidal currents only will be found extending a distance of 20 miles from the shore. Between 20 and 50 miles from the coast the currents depend upon the winds. With a long spell of variable weather, very feeble currents may be counted on.

The Cape Horn current: There is a very considerable movement of the surface waters, from west to east, off Cape Horn. The current runs down the western cost of Patagonia, setting SE.; it turns the island of Terra del Fuego, setting to the eastward; and then flows to the NE., passing through the straits of Le Maire and off shore of Staten Island. A part of this current flows to the westward and another part to the eastward of the Falkland Islands. Its velocity is as variable as the winds, which in these localities is subject to greater variations than in almost any other part of the ocean. However, we shall point out the mean velocities which may be experienced.

On the meridian of 80° W., and between 55° and 60° S., the velocity of the current setting to the SE. and ESE. varies from 12 to 24 miles per day. On the meridian 75° W., and at 40 leagues to the southward of Cape Pilar, the velocity of the current setting SE. is about 12 miles; on the same meridian and between 55° and 60° S., the velocity to the eastward varies from 18 to 24 miles per day. On the meridians of 70° and 71° W. the velocity to the eastward on 58° S. is about 30 miles per day; at 69° and 68° W., and to the southward of Cape Horn, the velocity to the eastward attains about 24 to 30 miles. To the SE. and E. of Cape Horn, the current begins to trend up the coast to NE. and NNE. with a velocity of 30 miles; near the land, between Cape Horn and Staten Island, the velocity to the NE. is about 24 miles.

A part of the waters, after having doubled Cape Horn and Staten Island, passes off to the southward of the Falklands, and sets ENE. with a velocity of 12 to 24 miles when on the parallels of 53° and 54° S. To the eastward of the Falklands, between these islands and the meridian of 52° W., the current flows NE. with a velocity of 12 to 24 miles until reaching the parallel of 50° S., where it loses all its force.

The other part of the current debouches from the straits of Le Maire, and, after having doubled Staten Island, sets to the NNE., and flows to the westward of the Falkland Islands. The greatest velocity, 36 miles per day, is observed at 10 or 20 leagues to the northward of the

straits of Le Maire. To the westward and abreast of the Falklands, the velocity to the NNE. is only 12 miles; and to the northward of the islands, as far as 50° S., the velocity of the current setting east is from 12 to 24 miles per day.

Farther to the northward of the islands, at about 47° or 48° S., the velocity of the current toward the NE. is from 12 to 20 miles per day.

To the northward and eastward of the Falklands, between 47° and 49° S., and 42° and 35° W., frequent sudden changes in the temperature have been observed at the surface of the ocean indicating the limit of the current from the antarctic polar, and Cape Horn region.

Traverse current: Between 30° and 40° S., and particularly from 30° to 35° S., there is a general movement of the waters *toward the east*, which commences on the meridian of 20° or 23° W., and extends to the meridian of 10° or 11° E. This current is designated by the name of *Traverse Current.* When reaching the meridian of 10° E., it trends to ENE., NE., N., and NW., mixing and uniting its waters, when between 11° and 13° E., with those of the branch of the South Atlantic connecting current, and flows up the western coast of Africa, as we shall point out further on.

Between 20° and 12° W., the current has a velocity of 12 to 18 miles per day; between 12° and 10° W., it varies from 18 to 30 miles; between 10° and 0° W., it is from 6 to 30 miles; and from 0° to 10° E., it varies from 6 to 24 miles per day. To the east of 10° E., between 35° and 40° S., the direction of the current is to ENE. and NE., and the velocity varies from 18 to 30 miles per day. On the meridians of 13° and 14° E. and between 36° and 37° S., the set is NE., with a velocity of 42 miles. On the meridians of 10° and 12° E. and between 28° and 30° S., the velocity is from 12 to 24 miles and the set is to the NW.

South Atlantic, or Agulhas current: The *Current* of *Agulhas* is the name applied to the movement of that very considerable body of water, which, at a high temperature, comes from the Mozambique Channel and the Indian Ocean, and flows to the SW., closely following the African coast between the meridians of 30° and 28° E. In this locality the current covers a space of about 50 miles in breadth and attains a velocity which, at times, is 4 miles per hour.

After reaching the eastern edge of the Agulhas bank, the greater part of these waters trend to the southward and afterward to the eastward and flow into the Indian Ocean again. The velocity of this return current is less; the temperature is not so high, and its track is on a more southerly parallel (40° S.) than the direct current to the SW.

However, the remainder of the current, that is, the smaller fraction of the waters coming from the Mozambique, &c., continues its course and passes around and above the southern part of the Agulhas bank, and flows to the westward when between 21° and 22° E., then after

passing this meridian it makes a sudden turn to the NW., passing around in front of Good Hope, Table Bay, &c., with a velocity of 12 to 24 miles per day. This branch unites with what we have pointed out as the *Traverse Current*, between the parallels of 25° and 30° S., and the coast of Africa and 11° E.; they together form an extensive movement toward the NW., with a velocity varying from 1 to 1.5 miles per hour, and which is felt as far as the parallel of 25° S., where the current covers, in breadth, the space between the meridian of Greenwich and 10° E.

The return to the eastward of the greater part of the waters of the Agulhas current is due to the action of the cold current which comes from the antarctic polar regions and flows to the NE. The zone of junction, where the warm and cold waters become mixed, occupies a considerable space to seaward of the Agulhas bank; and to this meeting of two currents of such different temperatures may be ascribed not only the exceedingly rough sea, and the irregularity in velocity and direction of the various currents, but also the very heavy gales of wind and excessively bad weather, which is known to exist in the locality of the Cape of Good Hope.

In summer, from January to March, the warm waters of the Agulhas current appear to extend quite a distance to the westward, viz, to the meridian of 10° E.; at this season the velocity and the volume of the waters attain their maximum. In winter, from June to September, this current diminishes in force and extent, and the cold waters from the polar region easily overcome and turn it back to the eastward.

The temperature of the waters of the Agulhas current is as follows:

	Spring.	Summer.	Autumn.	Winter.
	September to November.	December to February.	March to May.	June, July, August.
	° ′ ″	° ′ ″	° ′ ″	° ′ ″
Off Natal	71. 06	75. 92	75. 02	69. 98
Off Algoa Bay	69. 08	73. 94	73. 04	68. 00
Southeast of Agulhas Bank	64. 94	71. 06	69. 08	64. 94
Meridian of Cape Agulhas	62. 96	68. 00	66. 92	60. 98

Sheets of water lying close together, and alternately hot and cold, have been observed by navigators to the southward of the Cape of Good Hope, and extending to 42° or 43° S. This is the case particularly in the region comprised between the parallels of 36° and 38° S., and the meridians of 22° and 26° E., where the most sudden changes have been observed in the temperature of the surface waters. These variations of temperature are usually accompanied by marked changes in the condition of the weather and sea.

Trade-wind current: Throughout the region in which the SE. trade-winds blow, a westerly current may be counted on, which is produced by the drift of the surface waters under the constant pressure of those winds. This current has attained the regularity of the analogous westerly current, which is known to exist in the trade region of the North Atlantic Ocean.

However, we may point out this drift-current of the SE. trades as flowing, in general, to the westward or towards a point of the compass very close to west, with a mean velocity of 12 to 24 miles per day; the minimum velocity appears to be 6 miles, and the maximum 30 miles per day.

It must be understood that these remarks do not apply to that zone over which the SE. trades also blow, but in which we have said the *equatorial* current exists.

Western coast of Africa: From the parallel of 30° S. to Cape Negro, (about 23° S.), there is generally a well-established current setting to the northward. The velocity of this current is about $\frac{3}{4}$ mile per hour along the coast, and at a distance of 13 or 14 leagues off shore it attains a velocity of $1\frac{1}{2}$ miles per hour.

From Cape Negro to the Congo River the current is very irregular but sets generally to the NW.

Current of the Congo River: The change of color and the current produced by the waters of this river are observed, at times, for a distance, of 300 miles from its mouth. This current always sets to NW. or NNW., and loses itself in the equatorial current off the island of Annobon. Its velocity, which diminishes as it recedes from the coast, is, as a mean, about 2 miles per hour.

Icebergs or floating ice.—All along the southern part of the South Atlantic Ocean ice is found, brought by the Antarctic polar currents, and reaching different parallels, according to the meridian on which it happens to float, as also according to the season of the year. During the southern summer, from January to March, the icebergs reach the highest points, and sometimes are found nearly up to 40° S. between 20° and 25° W.

The table about to be given is taken from the English admiralty charts. It contains the latitudinal limits, for each five degrees of longitude, at each season of the year. It must be understood that these limits are often passed without encountering any ice; but it is none the less necessary to keep a bright lookout when approaching and until clear of them.

Table indicating, for different seasons, the latitudinal limits of icebergs on each meridian of five degrees.

Longitudes of 5°.	Latitudinal limits.				Longitudes of 5°.	Latitudinal limits.			
From the meridian of Greenwich.	January, February, and March.	April, May, and June.	July, August, and September.	October, November, and December.	From the meridian of Greenwich.	January, February, and March.	April, May, and June.	July, August, and September.	October, November, and December.
° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
100 00 W.	57 00 S.	57 55 S.	59 40 S.	53 20 S.	35 00 W.	40 15 S.	49 20 S.	45 30 S.	44 50 S.
95 00 W.	57 10	58 15	59 55	54 30	30 00 W.	39 50	48 40	45 10	43 50
90 00 W.	57 05	58 00	59 40	55 15	25 00 W.	40 15	48 15	45 00	44 00
85 00 W.	56 55	57 30	58 40	56 08	20 00 W.	40 30	47 55	45 10	44 12
80 00 W.	56 35	56 55	57 15	56 35	15 00 W.	42 30	48 00	45 15	44 30
75 00 W.	56 45	57 10	56 55	56 50	10 00 W.	43 10	48 25	45 10	44 45
70 00 W.	57 15	57 25	57 15	56 50	5 00 W.	43 00	49 20	45 40	44 45
65 00 W.	56 30	56 50	56 35	56 12	0 00	42 20	49 55	46 42	44 15
60 00 W.	54 45	55 55	55 15	54 10	5 00 E.	42 15	50 00	47 00	44 00
55 00 W.	51 45	54 15	54 00	52 00	10 00 E.	43 15	49 05	46 35	44 10
50 00 W.	47 25	52 20	51 45	51 05	15 00 E.	46 40	47 45	47 15	46 00
45 00 W.	44 35	50 45	48 00	48 55	20 00 E.	49 10	47 10	48 20	48 25
40 00 W.	41 35	50 00	45 50	46 35	25 00 E.	50 40	47 55	50 00	49 00

Barometer.—As was said in the general instructions for the North Atlantic Ocean, the indispensable object to be known, in order to make a proper use of the barometer, is the *mean barometric height*, or, in other words, the *mean level*, for the point where one happens to be.

The following is a table of this mean level, taken from Maury, for different parallels, of the South Atlantic Ocean, from the equator to 70° S.:

South latitudes.	Barometric level.	South latitudes.	Barometric level.	South latitudes.	Barometric level.	South latitudes.	Barometric level.
	Inches.	° °	*Inches.*	° °	*Inches.*	°	*Inches.*
Equator.	29. 918	25	30. 111	43 to 45	29. 780	55	29. 343
° 5	29. 957	30	30. 091	45 to 48	29. 630	60	29. 150
10	30. 001	35	30. 020	48 to 50	29. 570	65	28. 961
15	30. 048	40	29. 918	50 to 53	29. 481	70	28. 690
20	30. 091	40 to 43	29. 878	53 to 55	29. 363	.....	.....

The following table, taken from the English Admiralty Pilot-Charts, gives the mean barometric level, for each month of the year, between the equator and 60° S.:

Mean barometric height (South Atlantic Ocean).

South latitudes.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
° °	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
0 to 5	29. 890	29. 910	29. 910	29. 922	29 949	29. 949	29. 989	30. 001	30. 008	29. 961	29. 941	29. 930
5 to 10	29. 949	29. 941	29. 949	29. 941	29. 989	30. 008	30. 020	30. 028	30. 028	30. 020	29. 989	29. 961
10 to 15	29. 969	29. 981	29. 961	29. 989	30. 040	30. 048	30. 048	30. 060	30. 087	30. 067	30. 040	30. 001
15 to 20	30. 020	30. 008	30. 008	30. 028	30. 087	30. 087	30. 087	30. 127	30. 107	30. 087	30. 048	30. 048
20 to 25	30. 060	30. 048	30. 067	30. 048	30. 060	30. 138	30. 107	30. 158	30. 166	30. 178	30. 079	30. 079
25 to 30	30. 067	30. 048	30. 060	30. 067	30. 138	30. 087	30. 127	30. 178	30. 127	30. 158	30. 079	30. 079
30 to 35	30. 048	30. 048	30. 040	30. 067	30. 099	30. 040	30. 119	30. 099	30. 079	30. 079	30. 087	30. 001
35 to 40	29. 981	30. 040	30. 020	29. 902	29. 902	29. 902	30. 040	29. 941	29. 949	30. 048	30. 048	29. 969
40 to 45	29. 922	29. 949	29. 989	29. 949	29. 882	29. 890	29. 949	29. 930	29. 961	30. 020	29. 941	29. 949
45 to 50	29. 718	29. 784	29. 772	29. 769	29. 725	29. 654	29. 823	29. 831	29. 871	29. 772	29. 705	29. 674
50 to 55	29. 418	29. 449	29. 497	29. 449	29. 418	29. 489	29. 536	29. 567	29. 575	29. 489	29. 319	29. 438
55 to 60	29. 260	29. 162	29. 260	29. 213	29. 272	29. 292	29. 260	29. 292	29. 300	29. 115	29. 123	29. 221

We shall now proceed to give the general rules by which advantage may be taken of the barometric indications. We will also warn the reader that these rules will be modified, at the end of this article, when applied to the vicinity of Cape Horn, where the barometric level is subject to sudden changes of great range, and for which we shall give particular directions:

In the region of "general westerly winds," lying to the southward of the SE. trade-zone, the barometer generally foretells by several hours every change in the direction or force of the wind; gales are usually foretold from twelve to twenty hours in advance.

Ordinarily the E. winds, turning to NE. and N., cause a fall in the barometer;

When the wind reaches NW. the barometer ceases falling, and after a short time begins to rise;

The winds then hauling to W., SW., and S., cause the barometer to rise;

When the wind reaches SE. the rise ceases and a fall begins.

We may state, then, *as a general rule*, that the barometer is *high, or rises*, with *southerly;* and that it is *low, or falls*, with *northerly* winds.

When the barometric level is *steady*, that is to say, is *stationary* for or five six hours, no change in the direction or force of the wind need be expected.

If the level *oscillates*, that is to say, if it rises and falls slightly for a half a day, uncertain weather may be expected.

If the level rises slowly and steadily, from .03 to .07 inch in five hours, less wind or drier and colder weather may be looked for.

If the level falls in the same manner and at the same rate, more wind or warmer and damper weather may be looked for.

As a *general thing*, if the barometric column remains stationary at .15 to .19 or even at .39 to .47 inch, *above* or *below* the mean level, it will indicate well-established moderate weather; from the *southward* in the first instance, and from the *northward* in the second.

It is rare that the barometric column gets .59 to .78 inch or more, above or below the mean level, except during or just before very bad weather; that is to say, a great deal of wind.

However, it will not do, as is too often the case, to take for gospel truth that "*the barometer is very high or very low, according as to how it is about to blow.*"

It is better to adopt the following, which is more certain: "*It is a sure indication of a blow when the barometer suddenly rises or falls a considerable distance from the mean level.*"

It is best, then, when observing the barometer, to note, not only whether it is above or below the *mean level*, but the rate of change, for the watch, half day, &c. It is from the *rate* of *change* that the principal information is to be derived.

All moderate movements, either of rise or fall, announce moderate weather. On the contrary, every sudden movement fortells heavy winds.

The barometer being very low (.59 to .78 inch or more below the mean level) with NW. or northerly winds, a sudden rise, with a fall in the thermometer, foretells a shift of wind to W. or SW. and a southerly gale.

In winter, a sudden fall of the barometer below the mean and of the thermometer toward freezing point is a sure indication of snow.

Finally, as the changes of rise and fall of the barometer are more or less sudden, the weather foretold will be more or less prompt in its appearance, and will last a shorter or a longer time.

Barometer off Cape Horn: When endeavoring to gain information in regard to the weather off Cape Horn, by means of the barometer, persons will find themselves very greatly perplexed.

Numbers of captains who have doubled the Cape a great many times testify that the barometer cannot be depended on at all in that locality, and to prove their assertions they cite many examples in which there have been changes in the level of the column without any change of weather, and *vice versa*. Others assert the contrary with great persistence, and think their opponents do not know how to interpret the indications of their instruments; saying, it is true, certain exceptions may be noticed, but that such exceptions do not invalidate the general rule, &c.

It is easy to see the conflict of opinions by reading *Maury's Directions*, in which there are fragments of reports and logs and quotations, which leave no doubt of the want of unity of opinion in navigators on the subject. We shall give some of the more salient reports cited by *Maury:*

REPORT I.—The barometer is *always* low; it seems of no use.

II. The barometer is useless.

III. The height of the barometer is exceedingly variable, rising, falling, and passing rapidly from 30.07 to 29.17 inches, without any corresponding variation of weather.

IV. The barometer rising, but it serves as no guide.

V. The squalls and the barometer are variable, but without any apparent similarity. I do not have the slightest confidence in this instrument.

VI. The barometer has fallen 1.42 inches to-day without any serious wind.

VII. I observe the barometer attentively, but I do not think it can be relied on here, as in the North Atlantic Ocean.

VIII. From the parallel of the La Plata, my barometer has been almost useless. During some of the heaviest winds I ever felt, it stood at 29.17 to 29.41 inches, and *I have seen it fall to* 28.38 *inches, and the vessel remained under all sail.* The only thing noticed is that it falls with northerly and rises with southerly winds. During the last six weeks it has ranged from 28.38 to 30.00 inches.

IX. I have never seen the barometer fall so low, and I do not know what to think of it.

X. The barometer fluctuates from 30.03 to 29.3 inches, the weather and appearance giving no indication of storm or rain.

XI. The barometer continues to fall, although the wind is SW. I have always seen it rise with the wind from that quarter.

XII. The barometer ranges highest with the wind from WSW., and lowest with the wind from the northward. It either accompanied or followed the change, but never preceded it.

XIII. I do not see that the barometer is a guide to be depended upon. Certainly my experience would show its fall to be generally followed by delightful weather.

After having made those citations, Maury proceeds to add: These opinions all confirm the one I announced in 1834, which is as follows:

The indications of the barometer are of but little use off Cape Horn. The barometric level rises and falls several inches in a few hours; sometimes it rises most with a gale of wind, while at others it falls or remains stationary. Its *mean* height to the southward of the latitude of Cape Horn is 29.04 inches. When approaching Patagonia or Terra del Fuego from the Pacific, the wind being west, the barometer rises; if the wind is fresh it will rise above 30.00 inches, and often, under the land, above 30.47 inches.

After having given these reports, which nearly all tend to remove one's confidence in the use of the barometer off Cape Horn, we will reproduce a résumé of a letter of Commander Bailey's, written to Maury in 1854, and which will be found in the Sailing Directions. From this it will be seen that if the barometer is not made use of a very valuable source of information will have been thrown away:

In summer (December, January, and February) the winds from the eastward are rare and of short duration; we have had none. N. and NW. winds are always accompanied by cloudy and rainy weather, or fogs. Soon after they are established the barometer commences to fall, and continues to do so so long as they remain at N.; afterward there is generally an interval of two or three hours of calm and light variable breezes; then the winds pass to the S. or SW. with squalls, the fog changes into sleet and heavy snow, and heavy cumulus clouds rise to the SW. The mercury then begins to rise, and continues to do so while the wind remains from the southward. Thus a low barometer (28.5 inches for example) rises with a southerly, and a high barometer (29.8 inches for example) falls with a northerly wind. The 10th of January, in latitude 57° 40′ S., and longitude 79° 10′ W., at about 4 a. m., we had northwesterly winds, with which we carried all sail on the starboard tack, making a westerly board; the barometer gradually fell to 28.5 inches, when the breeze modified and hauled to the southward. We had hardly gotten the yards braced for the other tack, when the wind struck us so heavily we were obliged to let things go by the run, not even having time to reef down; happily we had gotten so far to the westward as to have no fear of the land. Under stay-sails alone the ship first logged 15 and then 14 knots. The barometer began to rise soon after the gale commenced, and reached 29.84 inches in thirty-two hours; it fell again, however, when the wind reached NW.

I have doubled Cape Horn three times, and a close observation of these phenomena has shown me several things which I will point out to you. So strongly am I convinced of what I advance, that I recommend all vessels (after they shall have passed

the Straits of Le Maire, which are not at all dangerous, and by means of which, at least, a degree to the westward is gained), when the wind is northerly and the barometer begins to fall, to count on that wind so long as the barometer continues to fall; when it reaches a minimum below 29.01 inches, and the weather falls calm, they may then be sure of southerly winds, and if possible, should get beforehand into a position to profit by them.

We will finish our extracts from Maury by the table of mean monthly barometric levels off Cape Horn, which is of very great importance, as it points out how much the level generally falls. (The mean level is 29.25 inches for the year.) There is no need, therefore, of being frightened at such depressions as 28.15 and 28.34 inches, which in other localities would announce the very worst of weather:

Barometric heights off Cape Horn.

Months.	Height in inches.	Months.	Height in inches.	Months.	Height in inches.	Months.	Height in inches.
January ..	29.33	April	29.17	July	29.13	October ...	29.33
February .	29.25	May	29.25	August....	29.25	November .	29.01
March	29.17	June.....	29.37	September.	29.37	December .	29.13

In the last few years we have read a great many reports and logs of officers who have sailed around Cape Horn and in the high southern latitudes, and we should say that these reports, &c., show, as a general thing, that confidence was placed in the barometer, although at the same time the very frequent irregularities in its indications are noted.

The divers opinions may be given in bulk about as follows:

The barometer, standing at about its mean level, between 29.01 and 29.33 inches, according to the time of the year, it will often be noticed to fall .39 inch in 4 hours, with the wind NW.; the column may then fall to 28.34 or even 28.15 inches, without any certainty of a coming gale. When the winds return to SW. the mercury may rise again, and will often pass, in 24 hours, from its lowest point to a height of 30.51 or 30.70 inches. If the NW. winds return in their rotation, the mercury will recommence to fall rapidly, and may reach 28.71 and 28.34 inches successively.

It results from this, that it is more necessary when off Cape Horn than in any other locality to take into account every indication which may give any degree of certainty to the prognostications deduced from barometric observations. Thus, in all probability, we may expect northerly winds when a *fall* of the barometer is accompanied by a rise in the thermometer, an increase of humidity in the hygrometer, and a cloudy horizon to the northward and NW., &c. Inversely, there will be many chances in favor of SW. winds when a *rise* of the barometer is accompanied by a fall in the thermometer, a decrease of humidity as shown by the hygrometer, and a clear horizon to the southward or SW.

In the same way the probabilities of bad weather will be all the greater when the movements of the barometer are very sudden, either

above or below its mean level, while at the same time a heavy swell is observed to set in, and after sunset or sunrise it becomes windy. This is particularly the case about the time of the changes of the moon; or at the rising or setting of the moon; in a word, whenever the weather has a nasty appearance.

We do not forget, when speaking of the sun and moon, *apropos* of the changes of the weather, that we lay ourselves open to the criticism of many persons. But it appears to us to be the better way to take into account *every* source of information, as also the *opinions* of the larger part of navigators, who are, in our estimation, too much interested in taking care of themselves when at sea to accept blindly certain theories which are stripped of every foundation. Undoubtedly, among those who oppose the belief of any agreement whatever between the appearance of the rising or setting sun, the phases of the moon, &c., and the changes of the weather, there are many who have followed the sea a long time; but, as a general thing, this opinion is sustained by men of science who work out their theories in the quiet of a study. Now, if it were possible, we think that in the interest of the progress of nautical meteorology, certain savants should "lie to" for several weeks in order to make observations between the parallels of 58° and 60° S., and the meridians of 63° and 65° W., as it would then be very hard indeed to refute, or even to shake, the public confidence in their convictions.

CHAPTER V.

INSTRUCTIONS FOR THE PRINCIPAL CROSSINGS OF THE SOUTH ATLANTIC OCEAN.

From the line to the Indian Ocean.—The general terms of the title of this article require some explanation. In the first place we take "*the line*" as the point of departure, because we suppose that this great circle will be crossed, by different vessels, in accordance with our instructions for the North Atlantic Ocean. At this time we shall repeat that the routes advised for the voyage from Europe to the equator are such that advantage may be taken of the SW. monsoon on the coast of Africa, in the months during which they are the best established; and that, consequently, the points at which the equator should be crossed are much farther to the eastward than those recommended by Maury. It is well known that Maury's route, which may be called the *western* one, applies particularly to sailing-vessels leaving the United States, and bound to the coast of America. These vessels, which were well known by the name of *clippers*, had everything to lose by running very far to the eastward, thereby lengthening their passage, and the necessity for making easting was so much the less from their being able to make splendid speed with the wind very close-hauled, with which power they could easily double Cape Saint Roque in case they found themselves to leeward of it. The advantages of this *western route* are not so great in the case of vessels sailing from the United States and bound to the Cape of Good Hope, or the Indian Ocean. We said, finally, that vessels with only medium powers of going to windward would do well not to *exaggerate* the route given by Maury, when bound to Brazil from the United States.

The route recommended by us for vessels sailing from Europe, and bound to the line, is taken from the instructions issued by the Meteorological Observatory of Utrecht for the use of the Dutch vessels engaged in the Java trade; and we may call it the *eastern* route in contradistinction to that of Maury. It is apparently possible to make certain remarks in regard to this eastern route, in a manner the counterpart of what was said in regard to the western one. It might be said, for example, that this Dutch route applies to vessels bound to the eastward of the Cape of Good Hope, and that consequently it will not do for those that are bound to Brazil or Cape Horn. But this *exaggeration* toward the east seems to us more apparent than real, since the Dutch

route does not cross the equator to the eastward of the meridian of 24° W., except in the months of July, August, and September, so that it will only be in this season that vessels bound to Brazil would find themselves thrown too far to the eastward. For vessels bound to Montevideo or Cape Horn this seems the better route, as it scarcely lengthens their voyage at all, and it has the advantage of carrying them to the line much more easily. Beyond the line they may soon make up for the lost time by running a much better course through well-established SE. trades; and further, they need have no uneasiness about Cape Saint Roque, which is a point of some importance. We shall, in a special paragraph, give instructions for those vessels which may be bound to Rio and Bahia.

To resume, the following principle, based on the mean of routes between the English Channel and the Indian Ocean, will be observed: *From May to November* it is best to cross the line *to the eastward of* 25° *W.; and from November to May to the westward of this same meridian.*

In the voyage of which we are speaking, as in all others in which *the line* is the point of departure, we will consider the points at which it is to be crossed, as indicated by the Dutch instructions for each month of the year, as the starting point or origin of the voyage. These points have already been given in our instructions for the North Atlantic Ocean.

When writing the *title* of this section, "*From the line to the Indian Ocean,*" we purposely left the particular point on the equator, at which it would have been crossed, in doubt; and, in fact, vessels leaving the line, and bound around the Cape of Good Hope, all take the same route, whatever may be their particular port of destination. The only difference in reality between them will be as to what parallel they choose on which to run down their longitude when in the Indian Ocean. On this last subject we shall enter into particulars when speaking of the voyages of circumnavigation.* Here we shall confine ourselves to recommending in a general way the choice of a parallel to the southward of 40° S., when bound either to China, India, or Australia. To the southward of this parallel the winds will be more favorable, the weather more pleasant, and the degrees of longitude much shorter.

In voyages of circumnavigation will also be found the best points at which to make a call for vessels from Europe to India or Australia; for the present it will suffice to say, that Palmas (Canary group) and the Cape de Verde Islands are the only points at which sailing-vessels may touch without losing time by their stoppage, or without a large expenditure of coal on the part of auxiliary steam vessels. The only port to be thought of on the American coast is that of Bahia, and that will cause a loss of fifteen days; further, even after leaving that place, vessels will find themselves far to leeward, and there will then be a voyage to be made without revictualing, which is about as long as though the Cape

* See General Examination of the Indian Ocean.

de Verdes had been the original point of departure. And a call at the Cape of Good Hope is still worse.

These preliminary explanations having been given, we proceed to point out, in detail, and for each month of the year, the points of crossings, and the principal circumstances of the route to be followed.

In *January* vessels leaving Europe in December, should, as we have already said, generally cross the line some time in January, and between 26° and 27° W. They should then steer to cross, if possible, the following points: The parallels 5° S. at 30° W.; 10° S. at 31° 45′ W.; 15° S. at 32° 15′ W.; 20° S. at 32° W.; 25° S. at 30° 30′ W.; 30° S. at 28° 15′ W.; 35° S. at 23° 15′ W.; 40° S. at 10° W., and 40° 45′ S. at the meridian of Greenwich. This point will, on an average, be reached in 24½ days after the passage of the line, and 47.6 days after leaving the Channel.

From the equator to 25° S. the chances of winds will be those indicated in SE. trade-winds, p. 103, for the months of January, February, and March. We shall only remark here that at this season there need be no fear of being unable to double Cape Saint Roque; the SE. trades haul to the eastward in proportion as the coast of America is neared. Later on, and after having reached the parallels of 15°, 20°, and 25° S., the wind will be seen to haul from SE. to NE. and N. Then beyond 25° S. it will continue to haul toward the NW., and the region of general westerly winds is thus entered. From 25° to 35° S., the winds will predominate from NE., N., and NW.; beyond 35° S. the winds will generally be well established from a westerly direction. In order to find the number of chances of calms refer to the table of Calms, p. 101.

After having crossed 40° 45′ S. at the meridian of Greenwich about the end of January, or the beginning of February, vessels should steer, with very favorable winds, to cross the following points: 41° 30′ S. at 10° E.; and 42° 30′ S. at 15°. Beyond this point the instructions for the Indian Ocean should be followed.

In *February*, vessels leaving Europe in January usually cross the line between 25° and 26° W. They should then steer to cut, as near as possible, the following points of crossing: 5° S. at 28° W.; 10° S. at 30° 15′ W.; 15° S. at 31° 30′ W.; 20° S. also at 31° 30′ W.; 25° S. at 30° 30′ W.; 30° S. at 28° 45′ W.; 35° S. at 22° 30′ W.; 40° S. at 10° W., and 42° S. at the meridian of Greenwich. This last point will be reached, as a mean, in 24.8 days after crossing the line, and in 51.7 days from the Channel.

After having crossed 42° S., on the meridian of Greenwich, about the last of February or the first of March, they should steer with very favorable winds to make the following crossings: 43° S. at 10° E., and 43° 30′ S. at 15° E.

The chances of winds and calms will be the same as for the preceding month, as the routes are sensibly the same.

In *March*, leaving Europe in February, the line is generally crossed about 26° W. From this point the course, if possible, should cross the following points: 5° S. at 29° 45′ W.; 10° S. at 31° 15′ S.; 15° S. at 31° 45′ W.; 20° S. at 31° 30′ W.; 25° S. at 30° 15′ W.; 30° S. at 27° 15′ W.; 35° S. at 23° 15′ W.; 40° S. at 10° W., and 41° 30′ S. at the meridian of Greenwich. This last point will be reached, as a mean, in 22.9 days from the line, and in 48.1 days from the Channel.

After having crossed 41° 30′ S. at the meridian of Greenwich, about the last of March or the 1st of April, the course should be laid, with the wind astern, so as to cut 42° 30′ at 10° E., and 42° 25′ S. at 15° E.

The observations made in regard to January and February also apply to the month of March respecting the chances of winds and calms to be encountered.

In *April*, vessels starting from Europe in March will generally cross the equator between 26° and 27° W., or more to the eastward, if possible, some time in April. They should then steer as follows: To cross 5° S. about 29° W.; 10° S. at 31° W.; 15° S. at 32° W.; 20° S. at 33° W.; 25° S. at 32° 15′ W.; 30° S. at 28° 15′ W.; 35° S. at 21° 15′ W., and 40° 45′ S. at the meridian of Greenwich. They should reach this point in about 25 days from the line and in 55 days from the Channel.

On this route, from 0° to 15° S., the winds will bear away from the SE. direction, as was shown in SE. trade winds, p. 103. From 15° to 20° S., the winds will blow principally between ESE. and ENE.; from 20° to 25° S., the winds will predominate from the eastward, but may vary from the southward to the NW., through E.; from 25° to 30° S. the winds will be principally from SE., E., NE., N., and NW. Beyond 30° S., and to the westward of 25° W., the winds will predominate from E., NE., N., and NW.; to the eastward of 25° W., the prevailing winds will be from SSE. to NE. and NW., variable from SW. and W. After having reached the parallel of 35° S., the winds will be well established from the westwadr, and will predominate from NW., with which a splendid easterly course may be run.

After having crossed 40° 45′ S. at the meridian of Greenwich, about the end of April or the commencement of May, the course should be made, with favorable winds, to cross 42° S. at 10° E., and 42° 45′ S. at 15° E.

In *May* and *June*, the routes to be followed are contained in the following table. The one given for May applies to vessels starting from Europe in the month of April, and reaching the line at the latter part of the same month or early in May; the other route is for vessels starting in May, and reaching the line in early June:

Route from the line to the meridian of the Cape of Good Hope.

Time of crossing the line.	South latitudes.											
	Equator.	5°.	10°.	15°.	20°.	25°.	30°.	35°.	39° 30'.	40°.	40° 15'.	40° 45'.
	W. ° ′	W. ° ′	W. ° ′	W. ° ′	W. ° ′	W. ° ′	W. ° ′	W. ° ′	W. ° ′	E. ° ′	E. °	E. °
May	27 10	29 30	31 30	33 30	34 45	33 00	28 00	17 15	0 00	2 20	10	15
June	28 00	29 30	32 00	33 30	33 30	32 15	31 45	22 30	2 20	0 00	10	15

The winds likely to be encountered on the various portions of these routes are about the same as those pointed out for the month of April. The distance from the line to the meridian of Greenwich will be made on an average in 25.2 days in May, and in 22.3 days during the month of June. Vessels leaving the Channel in April may expect to be, on an average, 55 days in reaching the same point on the meridian of Greenwich, and those leaving in May can expect to be 58 days in making the distance.

In *July*, vessels starting from Europe in the month of June will generally cross the line about the end of that month or the 1st of July, and between the meridians of 26° and 27° W., but as near 26° W. as possible. They should then steer to make, if possible, the following crossings: 5° S. at 28° 45′ W.; 10° S. at 31° 15′ W.; 15° S. at 33° W.; 20° S. at 33° 45′ W.; 25° S. at 32° 45′ W.; 30° S. at 29° W.; 35° S. at 20° 15′ W., and 40° S. at the meridian of Greenwich. This last point will be reached, on an average, in 25.2 days from the line, and in 56.6 days from the Channel.

Following this course the winds will be from SE. when between the equator and 12° or 13° S.; from 13° to 17° S. they will haul to ESE. and E., permitting vessels to run with a good rap full. From 17° to 20° S. the winds, although predominating from SE., will be interrupted by occasional breezes from the nothward and eastward. From 20° to 25° S. the SE. wind will be found to turn to the NE. and N., with a few accidental winds from the NW. Beyond 25° S. the rotation of the wind from SE. to NW., through E., is still more marked; the prevailing winds will still be those from E. and N.; and this will be the case until after passing to the eastward of 25° E. between 32° and 34° S. latitude. From this latter point the winds will be "general westerly,' but well-established and predominating from the NW., with which the course may be run with good speed.

We again refer to the chances of winds and calms as indicated in table of calms, p. 101; and will state that the winds prevailing on the western limit of the SE. trades and the coast of Brazil are mentioned in SE. trade winds, p. 103.

After having crossed 40° S., at the meridian of Greenwich, vessels should steer, the wind being astern, in a way to pass successively the following points: 40° 30′ S. at 10° E., and 41° S. at 15° E.

In *August* and *September*, vessels leaving Europe will reach the line in about 27 or 30 days; so the table about to be given for the months of August and September will serve for vessels which start on their voyage in July or August. It will be of great advantage to follow very closely, if possible, the points as given for these two months; nevertheless, no extraordinary exertion should be made to pass every single one of them, but they may, as a whole, be regarded as pointing out the best route:

Route from the line to the meridian of the Cape of Good Hope.

Time of leaving the line.	South latitudes.											
	Equator.	5°.	10°.	15°.	20°.	25°.	30°.	35°.	40°.	41°.	41° 15′.	42° 15′.
	W. ° ′	W. °	W. ° ′	W. ° ′	W. ° ′	W. ° ′	W. ° ′	W. ° ′	W. ° ′	E. ° ′	E. ° ′	E. °
August	24 00	28	31 00	32 30	32 45	32 15	27 45	19 00	2 30	10 00	20 00	....
September	23 15	27	29 30	31 30	32 15	30 15	27 45	22 30	1 40	7 10	9 20	20

In following these routes the time from the line to the meridian of Greenwich may be put down, as an average, at 26.9 days; and from the Channel to the same point at 57.1 days during the months of July and August. The same course may be run one month later, that is, in September, in 23.4 days from the line, and 55.2 days from the Channel to the meridian of Greenwich.

The routes for July, August, and September are analogous, and the chances of winds, calms, &c., are about the same as those already given for the month of July.

In *October*, *November*, and *December*, the points of crossing advisable are indicated in the following table for each month of the last quarter. It must be remembered that the route for October is to be followed by vessels starting from Europe in September and arriving at the line in October, and so on.

Route from the equator to the meridian of the Cape of Good Hope.

Time of crossing the line.	South latitudes.										
	Equator.	5°.	10°.	15°.	20°.	25°.	30°.	35°.	40° 45′.	42° 15′.	42° 30′.
	W. °	W. ° ′	W. ° ′	W. ° ′	W. ° ′	W. ° ′	W. ° ′	W. ° ′		E.	E.
October	25	28 15	29 45	30 30	31 30	30 00	27 45	21 15	Greenwich.	°	°
November	28	32 00	32 15	30 45	30 15	29 15	26 45	20 30	Greenwich.	15	20
December	27	30 15	31 45	32 15	30 30	29 00	27 00	22 45	1° W.	20	....

Vessels leaving the line in the month of October will be in a good position if they have crossed it to the eastward and near the meridian

of 25° W. In November and December, the winds being more favorable on the coast of Brazil, the line may be crossed without any inconvenience at 27° or 28° W. They will then be able to make their course, carrying a good full, with the trades well established from the SE., as far as 10° S. From 10° to 13° S., the winds will vary from SE. to E.; from 13° to 20° S., they will be from ESE., but varying, at times, to ENE.; from 20° to 25° S., the SE. winds will frequently haul to E. or NE.; from 25° to 30° S., the SE. winds haul gradually to the eastward, and then blow principally from NE. and N., and sometimes, but exceptionally, from SW.; finally, beyond 35° S. the general westerly winds blow principally from NW.

In this, as in the preceding season, the points of crossing as laid down should be closely followed, and particularly in the turning part of the route, lying between 25° and 30° S. Great care should be taken to avoid getting to the eastward sooner than shown by the table, as in that case the zone of most frequent calms would be encountered and the voyage very much lengthened; and on the course as indicated the general westerly winds will be reached in the quickest possible manner.

The routes as given for November and December are about the same as that for October, and the chances of winds, calms, &c., are about the same. In October the passage from the line to the meridian of Greenwich should, on an average, be made in 24.6 days; and from the Channel to the same point, in 55.2 day. In November, from the line to the meridian of Greenwich, should take 23.3 days; and from the Channel, 51.7 days. In December the same distances may be run in 21.7 and 49.6 days, respectively.

Return from the Indian Ocean to Europe.—In Remarks, &c., p. 178, will be found the general instructions, &c., for doubling the Cape of Good Hope, when bound to the westward, and for gaining a good position ourselves on the parallel of 30° S. In the present article we shall only occupy in regard to the route from the parallel of 30° S. to the line.

This second part of the route is very easy, and a résumé of it will be found in the two tables following. The first indicates for each season of the year the best points of crossing for vessels bound to the *United States*. By referring to the charts it will be seen that this route passes to the westward of Saint Helena, except in July, August, and September, when it passes to the eastward of that island. At all times the winds will be from SE., and well established, so that in July, August, and September it will be almost astern; while during the rest of the year it will be on the port quarter, and within a point or two of the stern. The route as laid down for July, August, and September passes almost in sight of Saint Helena and Ascension; consequently a call at either will not sensibly lenghten the voyage, as the only time lost will be that spent at the anchorage. However, a call may be made at Saint Helena without serious detention at any time of the year, as this island lies right in the track of vessels returning from India. In case of a call at that island, the route to be taken to the line may be found by draw-

ing a straight line on the chart, from the island through the points we are about to mention. In *January*, *February*, and *March*, the equator should be crossed at 30° W.; in *April*, *May*, and *June*, at 31° 10′ W.; in *July*, *August*, and *September*, 5° N. should be crossed at 27° 30′ W.; finally, in *October*, *November*, and *December*, cross the equator at 30° W. Beyond these points and to New York the route has already been given in our instructions for the North Atlantic, p. —.

The second table of this article points out, for each month of the year, the route to be followed by vessels returning to Europe from *India*. This table is taken from the "*Dutch Instructions, from Java to the Channel.*" The route upon the chart passes a short distance to the eastward of the islands of Saint Helena and Ascension; however, a call at the former only lengthens the passage by the time spent at the anchorage. As the winds are very generally well abaft the port quarter, we may say the trades are astern and well established for the whole of this part of the route. In case of stopping at Saint Helena, or if the island of Ascension has been sighted, for the purpose of rectifying the position, it will suffice for the remainder of the route to simply head for the point at which the equator is to be crossed. The points at which that should be done vary for each month of the year, and are indicated in the last column of the table, as also in the *Instructions for the North Atlantic*, p. 78. There will also be found in that same article the instructions for the remainder of the voyage to the Channel.

Table of the best points of crossing parallels and the equator when returning from the Cape of Good Hope to the United States.

Seasons of the year.	South latitudes.						
	30°.	25°.	20°.	15°.	10°.	5°.	Equator.
	E. ° ′	E. ° ′	W. ° ′	W. ° ′	W. ° ′	W. ° ′	W. ° ′
January, February, and March	12 40	4 50	3 00	10 00	16 50	23 40	30 10
April, May, and June	11 10	3 50	3 40	10 40	17 40	24 10	31 10
July, August, and September	11 00	5 20	0 40	6 10	11 40	17 00	22 10
October, November, and December	12 10	4 20	3 20	10 00	17 00	23 30	30 00

Table of the best points for crossing parallels and the equator when returning from the Cape of Good Hope to Europe.

Months of the year.	South latitudes.						
	30°.	25°.	20°.	15°.	10°.	5°.	Equator.
	E. ° ′	E. ° ′	E. ° ′	W. ° ′	W. ° ′	W. ° ′	W. ° ′
January	12 50	7 05	0 45	5 00	11 30	17 00	23 00
February	12 50	7 20	1 50	5 00	12 00	18 00	24 00
March	12 20	7 20	1 50	5 00	12 00	18 00	24 00
April	11 50	6 50	1 00	5 00	12 00	18 00	24 00
May	11 20	6 20	0 45	5 00	12 00	17 30	24 00
June	11 20	5 50	Meridian of Greenwich.	5 00	11 30	16 30	23 00
July	11 20	5 50		5 00	11 00	15 30	21 00
August	10 50	5 20		5 00	11 00	15 30	20 30
September	10 50	5 20		5 00	11 00	15 30	20 30
October	11 20	5 50	0 45	5 00	11 30	16 00	22 00
November	12 20	6 20	0 45	5 00	11 30	16 30	22 30
December	12 50	6 50	1 00	5 00	11 30	17 00	23 00

From the line to the Cape of Good Hope.—Vessels bound to the Cape of Good Hope should follow, as far as 35° S., the route as given in Line to Indian Ocean, p. 129. We have nothing more to say in regard to this first part of the route, except that a call on the American coast, at Bahia, for instance, will cause a proportionally longer delay in the case of vessels bound to the Cape than in case they are bound to India. The only stoppage which can be made, without any apparent delay, when bound from Europe to the Cape of Good Hope, is at the Canaries or the Cape de Verde Islands. When bound to the Cape it is best not to stop even at those places; but laying aside these considerations and supposing the vessel to have arrived at 35° S., we will proceed to point out, for each season of the year, the route which may be followed in order to reach the Cape.

In *January*, *February*, and *March:* At this season 35° S. should be crossed at about 23° W., as was said in Line to Indian Ocean, p. 129, then steering, with well established winds, predominating from N. and NW., in such a way as to cross 37° 30′ S. at 17° W.; at this latter locality, a series of winds, beginning at NE., and predominating from N., NW., and W., and then turning to SW., S., and SE., with 4 per cent. of calms, will be found; more easting should then be put in the course, which should be laid to just touch 38° S. at 10° W. After having passed this *meridian*, the wind will be more favorable, with fewer calms; and the longitude may be run down as far as 13° 40′ E. between 38° and 38° 15′ S. We consider it better to make easting on a parallel nearer to 40° than to 35° S., because, between 30° and 35° S., there is a large proportion of calms, with the winds exceedingly variable in direction, while between 40° and 45° S. calms are rare, and the winds blow almost always from NW. or SW. In this way it may be seen that there is an advantage in making easting on a parallel a little to the southward of 38° S.

Leaving 13° 40′ E., a little northing should be put into the course, and 37° 30′ S. should be crossed at 15° 20′ E. From this meridian to 20° E., the chances of winds are as follows: 20 per cent. of SE.; 25 per cent. of ESE.; 20 per cent. of WNW.; 12 per cent. of WSW.; 12 per cent. of SSW.; 8 or 9 per cent. of NW., and 2 or 3 per cent. of calms; that is to say, there are about 69 per cent. of chances favoring winds from a southerly direction, comprising 45 per cent. of chances of SE. and ESE. winds, which will force vessels to come to the wind on the starboard tack. There is consequently a great advantage in not passing the meridian of 20° E. to the northward of 37° 30′ or 38° S., so as to avoid having to make more than a NE. course; this latter is easy at all times, even with ESE. winds, which are the most frequent.

When approaching the coast of Africa, and just to the westward of 15° E., the current sets to the WNW. and NW. with a velocity of 12 to 24 miles per day. This is another reason for always steering a little to the eastward of the port of destination, so as to prevent being thrown

to the leeward of it. Near the coast the winds will be found to predominate from the SE., blowing at times with great violence; this is followed by light westerly breezes. A good lookout should be kept for occasional gales from the westward.

In *April*, *May*, and *June*, the parallel of 30° S. should be crossed, as was said in Line to Indian Ocean, p. 129, between 28° and 32° W., and 35° S. between 17° 15′ and 22° 30′ W., about. In this part of the route, and between 25° and 20° W., vessels will be exposed to frequent SE. winds, with which the starboard tack should be taken without the least hesitation. This should be continued until the winds haul to ESE., when the other tack should be taken, after which the winds will soon haul to NE. and NW. After crossing 35° S., between 15° and 20° W., the winds will be found from NE. to W., predominating from NW., and intermixed with 7 per cent. of calms, but with which 37° S. may easily be reached at 15° W.

From this latter meridian to that of 10° W., there will be about 14 per cent. of E., or *head* winds, and 86 per cent. of favorable ones. An endeavor should be made to reach 38° S. at 10° W., if it be possible; nevertheless, if a series of easterly winds should be encountered, it will be much better to take the starboard tacks aboard, and make a NNE. rather than a SSE. course; because, in that way, the winds will haul to the NE. and NW. much sooner than when running on the other tack, as the winds are more favorable toward the parallel of 35° S.

Beyond 10° W., between 35° and 40° S., the winds will always be more favorable from NW. to WNW., so that a good easterly course may be made between the parallels of 38° and 38° 15′ S., as far as 5° E., without a single chance of contrary weather.

Between 5° and 10° E., on the parallel of about 38° S., the winds will nearly always be favorable; notwithstanding this, there are a few chances in favor of a series of ENE. winds, with which the port tack may be taken and a SE. course made, until the winds haul to the northward. Between 10° and 15° E., which last should be crossed at 37° 30′ S., the winds will be very favorable, except a few chances of ESE. winds, with which a NE. course may be made. Between 15° and 20° E., the prevailing winds blow from between WSW. and ESE.; that is to say, they will generally be favorable for vessels bound to the Cape, provided they have taken the precaution to cut 20° E. *at or to the southward* of 37° 30′ S.

This recommendation is all the more important, as the current setting NW. and WNW. should be taken into account; this current flows with a velocity of from 12 to 24 miles per day, when near the African coast.

Close to the land the prevailing winds are those from the westward (after the month of May). The gales seem to alternate, first from the eastward and then from the westward, or *vice versa*.

In *July*, *August*, and *September*, as has already been said in Line to Indian Ocean, p. 129, 30° S. should be crossed between 28° and 30° W.,

and 35° S. between 19° and 21° W. In this part of the voyage, in case of head winds, from SE. for example, which by the way will be a very rare case, vessels may without preference take the port and starboard tack alternately until after 25° W. shall have been passed; but beyond this meridian the southerly board will be much the better. From 35° S., which should have been crossed about 20° W., the course should be laid with constantly favorable winds to just touch 38° S. at 10° W. Then it should run along this parallel of 38° S., with free winds, as far as 10° E. Beyond this meridian it may happen that a series of ESE. to ENE. winds of short duration will be found. However, the chances will be more favorable in this than in the two preceding seasons, in regard to the direction of the winds for the latter part of the voyage. The recommendation not to cross 20° E. to the northward of 37° 30′ S. need not then be so forcibly urged, although it is always well to follow it, because of the winds always bearing away from the southward when between 20° and 15° E., and the currents setting to W. and WNW. as the coast is approached. Near the land the prevailing winds will be from the westward. Violent gales are also experienced, commencing at W. and NW. and then turning to SW.

In *October*, *November*, and *December*, as was also said in Line to Indian Ocean, p. 129, 30° S. should be crossed between 27° 10′ and 23° W., and 35° S. between 21° and 23° W. When on this part of the route, in case of head winds, *i. e.*, from SE. or E., the port or southerly tack should be taken, as on that the chances are more favorable for an early change of winds. It will be advantageous, though, at *all* times, to avoid crossing 20° W. to the northward of 35° 30′ S. In this way a zone comprising, among other chances, 7 per cent. of calms, and lying to the northward of 35° 30′ S. and between 10° and 20° W., will be avoided. (See table, p. 101.) Then with very favorable winds a course may be steered to reach 38° S. at 10° W. From this meridian to that of 5° W., there will be a few chances of ESE. to NE. winds, with which that board should be taken which will give the greater amount of easting. Beyond 5° W. the course should be, as much as possible, between the parallels of 37° 30′ and 38° S., with winds constantly favorable, as far as 10° E. In passing this meridian, occasional SSE. and ESE. winds are encountered, and with which the starboard tack should be taken; but the boards should not lead to the northward of 37° S. before having reached the meridian of 15° E. From this latter point the course may be laid for the port of destination, taking care to run a little to the eastward of it, so as to allow for the currents which set to the W. and NW. near the coast of Africa. At this season, and when near the land, the weather is generally fine, though there may be occasional gales from the westward, and the SE. winds may attain the strength of tempests.

From the Cape of Good Hope to the line.—We pointed out in Indian Ocean to the line, p. 135, when speaking of vessels returning from India, the route they should follow from the parallel of 30° S to the

equator. These instructions evidently apply as well to vessels returning from the Cape of Good Hope, so that we shall now only speak of that part of the route lying between the Cape and the parallel of 30° S. In this part vessels will have the NW. current in their favor; this current has a velocity of 12 miles per day, and may at times attain one of 42 miles. (See the Agulhas current.) We shall proceed to give, for each season of the year, the chances, &c., of wind and weather which may be expected on the first part of the route.

In *January*, *February*, and *March*, when leaving the Cape, a course should be steered, with wind almost always favorable, to cross 30° S. about 12° E. If the winds should be from WNW., which is rarely the case, the port tack should be taken; and, as a general thing, whenever the wind heads the ship off her course, it will be best to take the tack which will avoid heading her off to the eastward of north or to the southward of west. We have already said that this WNW. wind will only be exceptional, and that it will not last any time, but will soon haul to SW. or SSW. Beyond 30° S. follow the route already given in Indian Ocean to the line, p. 135.

In *April*, *May*, and *June*, when leaving the Cape, the course should be laid to cross 30° S. at about 11° 30′ E. For the first part of the course, from 10° E. to the coast, there will be, besides the favorable current, some 20 per cent. of SW. and 49 per cent. of ESE., or 69 per cent. of favorable winds. There will also be, it is true, 6 per cent. of calms and 25 per cent. of chances of WNW. winds. In case of a series of the latter winds, the starboard tack should be taken so as to make a SW. course; the wind will soon haul to W., when the port tack should immediately be taken, so as to head NNW.; after which the winds will continue to haul to SW. and ESE., from which it will blow with tolerable persistency. After having passed to the westward of 10° E. and to the northward of 35° S., the chances of winds will be about as follows: 57 per cent. of SE., 34 per cent. of SSE., and 6 per cent. of NNW. winds, with 3 per cent. of calms, which shows that the chances will always be favorable. In case of NNW. winds the starboard tack should be taken, heading west, as this will not be a very bad course, and besides, the winds will soon haul, and the course may be run with winds nearly always from SSE. and SE. After having crossed 30° S. at 11° 30′ E., follow the points of crossing as pointed out in Indian Ocean to the line, p. 135.

In *July*, *August*, and *September*, when leaving the Cape, the course should be laid so as to cross 30° S. at about 11° 10′ E. The chances of winds that will be encountered between the coast and the parallel of 35° S., are about as follows: First, before reaching 10° 20′ E., there will be 16 per cent. of WSW., 16 per cent. of SSW., 17 per cent. of SSE., 19 per cent. of ESE., 5 per cent. of ENE., and 4 per cent. of NNE. winds; this gives 77 per cent. of *favorable winds*. There will only be 3 per cent. of calms, 6 per cent. of NNW., and 14 per cent. of WNW. winds,

with which the starboard tack should be taken, heading W., then WSW. and SW.; but if the winds continue hauling, the port tack should be taken, and a NNW., or better, perhaps, a NW. course may be made. After having passed to the westward of 10° E., and until 30° S. is attained, the chances of winds will be 18 per cent. of WSW., 31 per cent. of SSE., 14 per cent. of SE., 9 per cent. of ENE., 11 per cent. of NNW., and 12 per cent. of NW. winds, with 5 per cent. of calms. There will be 72 per cent. of *favorable* winds, and 23 per cent. of head or foul winds from NNW. to NW., with which the starboard tack should be taken, with the head to the W. and SW.; but if the wind continues to haul, go about, and a good route may be made to the NW. After having reached 30° S. at 10° 50′ E., the route should be continued as was pointed out in Indian Ocean to the line, p. 135.

In *October*, *November*, and *December* the parallel of 30° S. should be crossed as follows: in October, at 11° E.; in November, at 12° E.; and in December, at 12° 50′ E., as was stated in Indian Ocean to Europe, p. 135. The only winds which can be counted on, from the coast to 30° S., are those from SW. and SE., with 3 per cent. of calms. Remembering that the current also sets to the NW., it may be seen that it should be the easiest thing in the world, at this season, to steer for and to make the point given for crossing the 30th parallel. Beyond this, the instructions given in Indian Ocean to Europe, p. 135, should be followed.

From the line to the Pacific Ocean.—In our instructions for the navigation of the North Atlantic Ocean, when speaking of the routes from Europe and the United States (From France to the Equator, p. 71, and from New York to the Equator, p. 86), we pointed out the difficulties likely to be encountered in doubling Cape Saint Roque. We particularly insisted upon this point: that during the months of July, August, and September, it will be advantageous to cross the line to the eastward of the meridian of 24° W.; not only on account of the equatorial calms, but also because it will place vessels in a much better position with the SE. trades, to stand with a good full and clear the American coast.

In the present section we shall speak of the route to be followed between the parallel of Cape Saint Roque and the parallel of 50° S. in the Atlantic Ocean. Farther on (p. 164), we shall speak of the *Cape Horn* route, which extends from 50° S. in the Atlantic to 50° S. in the Pacific Ocean.

According to Maury, vessels bound to the Pacific Ocean, after passing Cape Saint Roque, should endeavor, the wind permitting, to cross 25° S. at about 35° W., but should never get to the eastward of 35° or 36° W. After passing the parallel of Cape Frio, they should make the most southing possible, endeavoring at all times to pass inshore of the Falkland Islands. The parallel of 50° S. should be crossed about as follows: In January, at 63° 04′ W.; in February, at 65° 22′ W.; in March, at 64° 16′ W.; in April, at 60° 52′ W.; in May, at 63° 40′ W.; in July, at 60° 52′ W.; in August, at 62° 58′ W.; in September, at 63° 42′ W.; in

October, at 64° 16′ W.; in November, at 62° 58′ W.; and in December, at 62° 46′ W. The distance generally run between these two parallels (that of Saint Roque and 50° S.) is about 2,900 miles; and, on an average, is accomplished in a mean of 31 days between February and August, and in a mean of 25 days during the five other months of the year. The longest passages are in August; and November is the most favorable month for it.

According to Kerhallet, from October to March, after having doubled Saint Roque, the coast may be approached with impunity. The prevailing winds are those from NE. to ENE., and the current sets down the coast from north to south. From this it may be seen that the passage is a very easy one to make. On the contrary, from March to October the winds blow from E. to ESE., and the current near the land sets up the coast from south to north; so that, at this season, to make the best passage vessels should keep at least 50 leagues off shore.

Finally, according to *King* and *Fitz Roy*, on the latter part of the route of which we are speaking, vessels when bound to the Pacific should keep at less than 100 miles from the coast of Patagonia, so as to be able to profit by the variations of the winds arising from the vicinity of the land; and also to avoid the very heavy sea, caused by westerly gales, which is met with farther off shore. Near the land, the direction of the general westerly winds follows the change in declination of the sun. Thus, from April to September, when the sun is in the northern hemisphere, the winds blow most often from WNW. to NNW.; heavy easterly gales, always very rare, are then oblique to the shore line, and can never endanger a vessel standing along it. Inversely, from October to March, while the sun is in the southern hemisphere, the winds are oftener from the southward and westward, and at times blow with exceeding violence; however, the land, being to windward, forms a shelter and the sea subsides with the gale. At this season the winds are often contrary; but as they are rarely persistent, and often vary from 6 to 8 points in a few hours, advantage may be taken of these variations and it will be best to remain close in shore.

By combining these indications with those taken from the wind and current charts, we have been enabled to establish the routes which appear most favorable to vessels bound to the Pacific. That part of the route which is comprised between the line and 50° S. (in the Atlantic), will be found, for each season of the year, in the following table. After this table we shall give, in detail, all the circumstances of weather, &c., which may be expected, as also the principal opinions upon which vessels may act.

It must be understood that the latter part of this route only applies to vessels intending to pass through the Straits of Le Maire and around Cape Horn. Those desiring to go through the Straits of Magellan should steer, after passing 40° S., to sight Cape Blanco, and should

then make a southerly course, keeping close to the land. (See Straits of Magellan, p. 171.)

Route from the line to 50° S., in the Atlantic, for vessels bound to the Pacific Ocean.

Season of the voyage.	South latitudes.										
	Equator.	5°.	10°.	15°.	20°.	25°.	30°.	35°.	40°.	45°.	50°.
	W. ° ′	W. ° ′	W. ° ′	W. ° ′	W. ° ′	W. ° ′	W. ° ′	W. ° ′	W. ° ′	W. ° ′	W. ° ′
January, February, and March	26 40	28 50	31 40	33 40	35 40	38 00	43 00	49 40	52 25	60 00	64 00
April, May, and June	27 10	29 30	31 40	33 40	35 40	37 30	40 40	47 10	54 00	59 30	63 10
July, August, and September	23 10	26 40	30 00	32 30	35 00	40 00	45 00	50 00	57 30	62 30	63 40
October, November, and December	27 40	29 40	31 40	32 30	34 30	37 30	41 00	47 30	54 30	60 00	63 40

In *January*, *February*, and *March:* At this season it will be very easy in the first part of the voyage to follow the points of crossing pointed out.* Between the line and 10° S. the wind will be from SE.; between 10° and 17° S. it will haul to ESE. and E.; between 17° and 20° S. it will be from ESE., E., and NE.; and finally, from 20° to 25° S. it will be from NE. and N. The indications of reigning winds are given more in detail in SE. Trade Winds, p. 103. Between the line and 5° S. the current will be found to set toward the W.; and from 5° to about 30° S., it sets to the SW., or in a favorable direction; the velocity and direction of this current, known as the *Brazil* current, are given in South Atlantic Currents, p. 116. Having arrived at 25° S., which should be crossed at 38° W., the wind will be favorable, and will continue so as far as 27° S.; but to the westward of the meridian of 38° W., the winds will predominate from E. to NE. and N., with a few chances (and but very few, we must say) of SW. and S. winds. With a SW. wind the starboard tacks should be brought aboard, and a SSE. course made; with south winds the port tack should be taken, and a WSW. course run. But, at the same time, care should be taken to keep to the eastward of the meridian of 43° W., to avoid falling into zones of 20 to 25 per cent. of calms.

From 30° S., which should be crossed at about 43° W., to 35° S., crossed at 50° W., the chances will be as follows: *To the eastward of* 45° *W.*, prevailing winds from SE., NE., N., and NW., and occasionally from SW.; with the latter, the starboard tack should be taken so as to head SSE., but vessels should go about so soon as the wind hauls to the southward. *To the westward of* 45° *W.*, the winds will be still more favorable; they will blow principally from SE. to N., through E., and sometimes from SW. to S. With SW. breezes the starboard tack should

* We shall not trouble ourselves, at this place, with the difficulty of doubling Cape Saint Roque, as that was sufficiently illustrated in paragraphs France to the Equator, p. 71, and New York to the Equator, p. 86, of the instructions for the North Atlantic.

be taken, to head SSE.; but when the wind hauls to S. vessels should go about so as to head WSW.; but in this latter case great care should be exercised to keep to the eastward of 49° 10′ W., so long as vessels are to the northward of 34° 30′ S.; otherwise they may fall into unfavorable zones, where 13 per cent. of calms will be encountered.

From 34° 30′ to 37° S., the La Plata current (South Atlantic Currents, p. 116) setting to the NE., will be contrary. The velocity of this current is exceedingly variable.

Between 35° S., to be crossed at 50° W., and 40 S., to be crossed at about 55° 25′ W., the prevailing winds are those from SE., NE., N., and NW., with which the coast may be approached so as to be in the best possible position in case of encountering SW. or S. winds, which are quite persistent, and, of course, contrary. When the wind blows from SW. or SSW., vessels will be forced to run to the SSE. or SE., but they should never pass to the eastward of 50° W., provided they can possibly avoid doing so. So soon as the wind hauls to S. the other tack must be taken, so as to stand in nearer to the land, where the prevailing winds will be from NW., and, consequently, favorable.

From 40° S., to be crossed at 55° 25′ W., to 45° S., to be crossed at 60° W., the most frequent winds are those from NE. to NNE. and NNW., with which vessels may head their courses, standing in for the coast with impunity. In this way all danger of being drifted too far to leeward will be avoided in case of a series of WSW. or SW. winds, as, with these, vessels are constrained to take the starboard or offshore tack, and to head S. or SE.

To sum up, the nearer vessels are to the land (between 90 and 150 miles) the lighter will be the sea and the weaker the contrary currents, and the less danger there will be of being thrown very far to the eastward by SW. winds.

The latter part of this route, from 40° to 45° S., and to the southward of this parallel, is very tedious, on account of the frequency of the SW. winds. So we think that, in order to be certain of passing somewhere near the points indicated, which represent the *axis* of the route, vessels should profit by every favorable slant to make westing at the same time they are making southing, and to make a course, with those winds, parallel to and about 100 miles *to the westward* of the route laid down. In this way, when the winds haul to the southward and westward, vessels may lay all the closer to it without the fear of being driven to the eastward by the wind and the current, which last, coming from Cape Horn and the Straits of Le Maire, sets to the northward, to the NE., and to the eastward, following around the western and northern sides of the Falklands.

In *April*, *May*, and *June*, the first part of the voyage, as far as the parallel of 20° S., is very easy. Between the line and 5° or 6° S., the equatorial current is favorable, setting to the westward; and from 3° to 25° S. the Brazil current, setting SW. along the coast, is also favorable; the velocity of these currents is given in South Atlantic currents,

p. 116. From the line to the parallel of 6° S., the winds will be SE; from 6° to 10° S., they will vary from SE. to SSE.; from 10° to 13° S., they will be from SE., varying to SSE.; from 13° to 17° S., they will vary from SE. to E., and NE.; from 17° to 20° S., they will vary from southward to northward through E., and will predominate from SE. to NE. (See SE. trade winds, p. 103.) With southerly winds, which commence to blow occasionally between 17° and 20° S., the port tack should be taken; and, as the wind will soon haul to SE. and E., vessels may keep coming up, so as finally to make a good course along the line joining the points of crossing which were given in the preceding table. After having crossed 20° S. between 35° and 37° W., the course should be laid to reach 25° S. at about 37° 30′ W. In this zone the winds will blow most often from S., SE., and NE., and occasionally from SW. With the latter the starboard tack should be taken, but so soon as the wind hauls to S., the other tack must be taken, so as to head about WSW. However, if they continue to blow from S. without hauling to SSE. or SE., which, by the way, they rarely do, care must be taken to avoid getting to the westward of 39° W., as in such a case the danger of encountering calms, rains, and stormy, squally weather will be incurred. By crossing 25° S. at 37° 30′ W., vessels will be in a very good position. From this point the winds will frequently be from SW., varying to S., then from SE., from NE., and dominant from N. With the SW. and SSW. winds, the starboard tack must be taken; with S. winds vessels should take the port tack, without passing to the westward of the meridian of 39° W., so long as they are to the northward of the parallel of 27° 30′ S., and without passing that of 40° W., before reaching the parallel of 29° 30′ S. Unless these precautions are observed vessels will be likely to run into zones containing from 14 to 15 per cent. of calms. It will be more prudent in sailing-vessels to cross 30° S. at 40° W.; but with well-established breezes from SE. to NE., the following crossings may be made with impunity: 39° S. at 40° W., and 40° S. at 41° or 41° 30′ W.

After having passed the parallel of 40° S., advantage should be taken of every favorable slant, in order to get to the westward; it will be best, if the weather, &c., allows, to reach 32° S. at about 45° W., because to the westward of this meridian the winds are much more favorable than to the eastward. In the eastern zone, lying between 30° and 35° S. and 40° and 45° W., the prevailing winds are those from NW., W., and SW., with occasional SE. and NE. and an equal number of S. and N. winds. In the western zone, situated to the westward of 45° W., but between the same parallels, the NW. and SW. winds are about equal in number to those from NE. and SE., while the prevailing winds are those from N. But in all passages vessels should seek to cross 35° S. at about 47° 10′ W., and, if possible, at 48° W. From this point they may steer to cross 37° 30′ S. about 50° or 50° 20′ W. During this small part of the voyage the winds will generally be from N., varying to NW. and W.; however, since there is always a probability of the wind

hauling to SW. and S., it will be well, when the wind is ahead, to make as much westing as possible, so as to keep that side of the route as given by the points of crossing. Between the meridians of 45° and 50° W., there will be about 8 per cent. of chances of calms. (Table of calms, p. 102.) To the westward of the meridian of 50° W., the winds will be better established and fresher while blowing from N., NW., W., SW., and S. Accordingly, when the wind is between N. and NW. a WSW. course should be run. If the parallel of 40° S. is crossed at 55° or even 56° W., vessels will be in an excellent position, but it happens more often that the winds haul ahead to W., SW., and S. In such a case, vessels will be obliged to take the starboard tack, heading, successively, SSW., SSE., and SE.; but so soon as the wind heads them off to the eastward of SE., they should go about and stand to the westward, endeavoring to remain to the westward rather than to the eastward of the indicated route.

This same recommendation applies to the rest of the voyage between 40° and 50° S. Thus, between 40° and 50° S., and to the westward of the meridian of 55° W., as far as the American coast, the winds nearly always blow from NNE. to SSW. through. W, and predominate, particularly, from NW. to SW. It is only occasionally that the winds blow from SE. to NE. Under these conditions it may be seen that no chance should be neglected to make westing at the same time that southing is being made, in order to cross 45° S. at 60° W., or even more to the westward if possible, say at 61° or 61° 30′ W. From 45° to 50° S., and to the westward of the meridian of 60° W., there will be 41 per cent. of WSW., 25 per cent. of WNW., and 25 per cent. of N. winds, and also 9 per cent. of calms. As a general thing, it will be very easy in this zone to make a good run, and vessels may be considered in good positions when they are able to cross 48° S. at 63° W., and 50° S. at about 63° 10′ W.

In *July*, *August*, and *September:* At this season it is impossible to avoid passing through the zone of *pamperos* or La Plata SW. winds; these are felt particularly about the end of August, and lengthen the voyage some two or three days, also straining a vessel a great deal by forcing her to lie to for 24 or 36 hours. The route indicated in the table at the beginning of this section, which we ourselves developed, is calculated to carry vessels through in the shortest possible time. And, further, it leads (between 25° and 35° S.) through the zone of fewest calms, as also (between parallels 30° and 60° S.) through the region where the SW. gales are most rare.

The meridian at which the equator should be crossed is given in paragraphs France to the Equator, p. 71, and New York to the Equator, p. 86, of the instructions for the North Atlantic. This would be at about 23° W., when coming from the English Channel, and 29° or 30° W., when coming from the United States. Between the equator and 10° S., the winds will be from SE., and vessels will be set to the westward by the equatorial current. From 10° S. the current will be favorable, and

the wind will begin to haul. (See Prevailing Winds, &c., p. 111, and Currents of South Atlantic, p. 116.) At 12° or 13° S. the winds will be from ESE.; between 17° and 20° S. they will be variable from ESE. to ENE., and even to NE.

The parallel of 20° S. may then easily be crossed between 35° and 36° W. After this the winds will be found to predominate very strongly from NE., though at times varying to SE. or N. Sometimes a few SW. breezes may be encountered, but they never last for any length of time, and rarely attain the force of gales. When they are experienced the starboard tack should be taken, heading SSE., and the wind will soon haul to S. and SE., and become favorable. To sum up, as a general thing the course may be steered, with free winds, to cross 25° S. at 40° W.*

From this point, when running to cross 30° S. at 45° W., there will be about 8 per cent. of calms, with the winds predominating from SE. to NE., or, in other words, very favorable. Sometimes, but rarely, a series of SW. winds, with which a SSE. course can be made, will be encountered; but these winds are of short duration, and when they haul to S. the other tack should be taken immediately, so as to stand to the WSW.; at the same time it must be observed that the meridian of 45° W. should never be passed before the parallel of 30° S. is reached; because north of this parallel 16 per cent. of calms will be experienced instead of 8 per cent., as is found to the eastward; and, further, SW. gales are frequent in that locality.

Beyond 30° S., which should have been crossed as 45° W., the course should be run to reach 35° S. at about 50° W. During this part of the voyage there will be from 8 to 9 per cent. of calms, 18 per cent. of SE., 23 per cent. of NE., 15 per cent. of N., 13 per cent. of NW., and 23 per cent. of SW. winds. From this it may be seen that there will be about 23 per cent. of head winds, rather frequent calms, and a few gales from NW. and SW., for which a lookout must be kept.

At this place we must again remark that it is important to keep to the eastward of 45° W. when to the northward of 30° S., and that it is necessary, in order to make a good voyage, not to cross 30° S. anywhere to the eastward of 45° W. In fact, the meridian of 45° W. separates two zones. In the first place, to the northward of 30° S., vessels to the eastward of this meridian have the winds more favorable, less calms, and about one-fourth the number of gales that are experienced by vessels to the westward of this same meridian. On the other hand, after the parallel of 30° S. is passed, the vessels to the eastward of 45° W. have twice as many chances of SW. gales, and about half as many more chances of calms (13 instead of 8 per cent.) as vessels to the westward of that meridian.

* Care should be taken not to pass to the westward of 40° W. before reaching 25° S.; otherwise a zone containing 9 per cent. of calms will be entered, and the route thereby lengthened very much.

Returning to that portion of the route between the parallels of 30° and 35° S. we can think of nothing else to advise, except that every effort should be made to cross 35° S. as far as possible to the westward, say at 50° W. This position may generally be reached with ease, provided care is taken to make all possible westing whenever the winds haul to NE., N., or SE. In this way vessels may get about 100 miles to the westward of the route already indicated, so as to avoid being blown too far to leeward in case of SW. weather. It must be well understood, however, that in this season the SW. gales may be expected from the parallel of Saint Catherines to that of 40° S.; but at the same time the route we have pointed out is the line upon which the least number will be met with.

In case 35° S. shall have been crossed at 50° W. vessels will be in a very good position, because between the parallels of 35° and 40° S., and west of 50° W., the chances of winds will be very favorable. They will find 16 per cent. of S., 20 per cent. of SE., 26 per cent. of NE., 12 per cent. of N., and 12 per cent. of NW. winds; that is to say, 86 per cent. of favorable, and about 13 per cent. of SW. winds, as also 1 per cent. of calms, or only 14 per cent. of chances of contrary winds. We call the S. winds favorable because they do not last for any length of time, and because they allow a WSW. course to be made. The more westing made before reaching 40° S. the better it will be. If the weather will permit the crossing of 40° S. to the westward of 57° 30′ W., not a moment should be lost in doing so. In fact, between the parallels of 40° and 45° S. the winds will be from NW. to SW., but predominating from the last unfavorable direction in proportion as one is to the eastward of the meridian of 60° W. From the above, we may see that if, after having crossed 40° S., the good luck of finding NW. winds is experienced advantage may be taken of them to cut the meridian of 60° W. at the soonest possible moment, as to the westward of it there will be 22 per cent of N., 33 per cent. of WNW., 41 per cent. of WSW. or SW. winds, as also 4 per cent. of calms. To sum up, there will be about 55 per cent. of very favorable, and 41 per cent. of winds with which at least a S. or SSE. course may be made.

The route pointed out, when between 35° S. crossed at 50° W., and 45° S. crossed at 62° 30′ W., is the one which should be preferred when the chances of winds to be encountered are favorable. In this case it is the very best. But if a series of WSW. or even SW. winds are experienced, it will be better not to try it. It is true that one may in this way be forced to cross 45° S. between 60° and 58° W.; but even in this case there is a chance of passing to the westward of the Falkland Islands. In fact, to the southward of 45° S., and between the meridians of 55° and 60° W., the winds blow almost constantly from NE., NW., and WNW.; so that it will be very easy, as a general thing, for vessels which are to leeward, as pointed out, to run to cross 47° 30′ S. at 60° W., or even farther to the westward, if possible. Between the meridian

of 60° W. and the coast of America, and from 45° to 50° S., the dominant winds are from NNE. to NNW. and WSW., and the accidental are from SE. Consequently the hope may always be entertained of crossing 50° at 62° 30′ W., even when starting from 47° 30′ S., at 60° W.

In regard to vessels which have crossed the parallel of 45° S. at 63° W., we can say that they may easily steer for the point of crossing as indicated, 50° S. at 64° or 64° 30′ W., when they will be in a favorable position for making the remainder of the voyage.

In *October*, *November*, and *December* is the best season of the year in which to make this voyage, and it may be expected to be much quicker, as well as more pleasant. By referring to the table given in the first part of this section, the route which, we think, should be followed will be found. We advise a more strict adherence to the indicated route at this than any other season of the year.

We also recommend that vessels should not get so very far to the westward of the points of crossing as at other times, and particularly when between the parallels of 25° and 40° S., as otherwise they may get into zones of calms which are exceedingly persistent. (See table of calms, p. 102.)

Between the line and 10° S. the winds will be from SE., and the equatorial current will be found to set to the westward. From 10° to 25° S. the Brazil current will be favorable. (See currents of South Atlantic, p. 116.) Between 10° and 13° S. the winds will be from SE., varying at times to E. and ENE. From 13° to 17° S. they will be from ESE. to ENE.; from 17° to 20° S., by keeping between 32° 30′ and 35° W., they will vary from ESE. to NE. and N. The same favorable chances will be found between 20° and 52° S., except that at times there may be a few southerly breezes, but these are very rare. The parallel of 25° S. should be crossed at 37° 30′ W., and beyond this parallel the winds will be from SE. to NE. and N., with which it will be very easy to reach 28° 30′ S. at 40° W.

Beyond the latter point and to the westward of the meridian of 40° W., the winds will predominate from SE. to E. and NE.; but they may begin to be felt from a southwesterly direction, there being about 20 per cent. of chances in favor of these winds. As a general thing, however, the parallel of 30° S. may be reached at about the meridian of 41° W. By joining the two following points with a line on the chart, 35° S. at 47° 30′ W., and 40° S. at 54° 30′ W., we will have the "type route," and vessels should never get more than 100 miles to the westward of it, while they may get from 40 to 60 miles to the eastward without danger of being far enough to leeward to cause any anxiety.

From 30° to 35° S., between the meridians of 40° and 45° W., there will be 22 per cent. of SE., 27 per cent. of NE., 12 per cent. of N., 17 per cent. of SW., and 18 per cent. of S. winds, besides 4 per cent. of calms; that is to say, there will be 61 per cent. of very favorable, 17 per cent.

of head, and 18 per cent. of oblique winds, with the last-mentioned of which a course of WSW. may be made; but this should not be allowed to carry vessels more than 30 miles to the westward of the course. Between the same parallels, but to the westward of 45° W., the chances will be even better, viz, there will be 15 per cent. of SE., 28 per cent. of NE., 22 per cent. of N., 9 per cent. of NW., 8 per cent. of W., and 14 per cent. of SW. winds, besides from 4 to 5 per cent. of calms; that is to say, 82 per cent. of favorable, and 14 per cent. of head winds.

Therefore it will be advantageous, when in that part of the voyage between 30° and 35° S., to cross the meridian of 45° W. at 32° or 32° 30′ S., if the weather will permit.

From 35° to 40° S., but to the eastward of 50 W., there will be about 19 or 20 per cent. of SW., and 8 or 9 per cent. of W.; that is, 28 per cent. of unfavorable winds.

On the other hand, there will be 70 per cent. of chances of favorable, viz, NE., N., NW., S., and SE. winds, with which a good course may be made heading between S. and W. After the meridian of 50° W. shall have been crossed, the winds will be still more favorable, so that every endeavor should be made to cross it as soon as possible, that is to say, about 36° 30′ S. To the westward of 50° W., there will be found only 10 per cent. of SW. winds and 6 per cent. of calms; the other 84 per cent. of chances are in favor of SE., NE., N., and NW., or very favorable winds. Consequently it will generally be very easy to steer to cross 40° S. at 54° 30′ W., which will be the very best point of crossing for sailing-vessels. An auxiliary steam vessel may cross at a meridian still farther to the westward, at 55° 10′ or 56° 10′ W., for example, provided the weather and other circumstances are favorable; by following this advice they will have the advantage of being well to windward, and consequently in a good position. But the same course should never be followed by sailing-vessels, because they will be exposed to the mishap of having to remain almost stationary for a long time to the westward of the meridian of 55° W., and to the northward of 40° S., in which localities there are about 16 per cent. or more of calms.

Between 40° and 50° S., after having joined the points of crossings as given in the table at the commencement of this section, it should be adopted as a rule, to *keep 50 or 60 miles to the westward of this route* so long as the weather permits; and this may be done without fear of the vicinity of the land. The winds will predominate from NE., NNW., WNW., and WSW., and will blow only about 10 per cent. of the time from SW. and SSW. In case a series of these head winds are encountered, it will be a matter of congratulation that the precaution of getting well to the westward has been taken. There will also be time, before being set very far to leeward, for the wind to blow itself out from SW., and to haul to the southward, when, by taking the other tack, a good position may again be obtained.

In closing, we again repeat the principle already announced—the farther to the westward one is after crossing 40° S. the more the winds will be from NW.; and inversely, the farther one is to the eastward of 60° W., themore the winds will be from SW. The advantages, then, to vessels which get well to the westward after passing 41° or 42° S. consists in having more sea-room and more favorable winds than do those vessels which make every endeavor to get directly to the southward.

CHAPTER VI.

Return from the Pacific to the line.—The route to be followed when returning from the Pacific to the line is a very easy and simple one. Off the Cape the winds nearly always blow from the westward, while the current, in rounding Terra del Fuego and Staten Islands, generally sets to the eastward. (See Currents of South Atlantic, p. 116.) Consequently it is very easy to make easting and to double the Cape, by keeping between 50 and 100 miles from the land, and then steering NE. to cross the parallel of 50° S. between 50° and 54° W.

A worse determination could not be taken than that of passing inshore of the Falkland Islands. Although it may be advanced that by so doing advantage may be taken of the favorable current, still we must not forget that precious time will be lost by making the necessary *détour* when the winds are more favorable to make a good course to the eastward on the parallels where the degrees of longitude are so much shorter. Consequently we say that the course should lead off-shore of the Falklands, except when bound to Brazil or the Rio de la Plata, but in no case when it is desired to make a quick run to the line should the course be inshore.

Having reached 50° S. at 52° or 53° W., from which point the course proposed to be followed to the line might be traced on the chart, the chances of head winds and calms to be encountered between 25° and 40° S. become a source of uneasiness, provided it is intended to follow the arc of a great circle, which, as we all know, is the shortest distance between any two places on a sphere. Accordingly, it may be necessary to make a *détour* to the eastward in order to reach the trades in the quickest way possible, as with their aid the line may easily be reached at any proposed meridian; these are given in paragraphs (Equator to France, p. 78, and Line to New York, p. 94) of the instructions for navigating the North Atlantic Ocean.

We said before that no one should pass inshore of the Falkland Islands except when bound to Montevideo or up the river. Referring to this remark, we must say that vessels bound to Europe or the United States will do much better by keeping straight on their voyage without making any stops at all. But if they are obliged to make a call at some port, they should by no means choose that of Montevideo, as that will lengthen their voyage about 650 miles in distance, and a week at least in time, without counting the chances of encountering gales which

are frequent in July, August, and September, and the inconvenience of the roads of Montevideo, where large vessels are obliged to anchor a long distance from the shore. A call at Saint Helena is the easiest and the most resorted to. It is true that it lengthens the voyage from 450 to 900 miles in distance, according to the season, and from 4 to 6 days in time; but it has the great advantage of lying in the trade region, where there need be no doubt whatever of the ability of the vessel to leave port whenever she desires.

Let us now speak of a call at the Falkland Islands. This is the only one which does not sensibly increase the distance to be run; nevertheless, we do not feel authorized to recommend it to any vessels, except those which may have sustained damages when off the Cape, or which, by some mishap, are forced to revictual, or to recruit from their heavy passage into the Atlantic. When coming from Valparaiso, or Callao, as a general thing, the time spent at sea will not be sufficient to force a call in port before reaching Saint Helena. Those vessels which may have sailed from San Francisco or New Caledonia may perhaps prefer to touch at the Falklands, and especially if they are bound to the United States; not only because a call at those places divides their voyage into more equal parts, but also because a call at Saint Helena lengthens the voyage of vessels bound to the United States much more than it does that of vessels bound to Europe, which latter should cross the equator at least 100 leagues farther to the eastward than the former. To sum up, the best stopping-place in the South Atlantic Ocean for vessels running from the Horn to the line is Saint Helena, if we look to security in navigation; or Port Stanley (Falklands) if it is desired to lengthen the distance the very least possible amount, and no fear is entertained of staying a longer time in the high southern latitudes.

Although we do not think that what precedes is of such a nature as to make any one prefer a call at the Falklands, still we shall give a few details in regard to Port Stanley.

A *fixed, bright light* has been established on Cape Pembroke, at a height of 110 feet above the mean level of the sea, and which, in ordinary weather, should be seen from a distance of 14 miles. This light may be seen from any direction off shore of the coast, but is hid by the coast of Port William, between the bearings of NW. ½ N. and SW. ½ W. The light-house tower, which is 60 feet high, is round, and made of iron, and painted in horizontal bands of red and white; it stands in latitude 51° 40′ 42″ S., and longitude 57° 41′ 48″ W. of Greenwich. Cape Pembroke is the easternmost point of the Falkland group, and is the southern extremity of Port William, in which, on the southern side, lies Port Stanley. The light bears S. by E. ¼ E. from Uranie Rock, which lies 1 mile to the eastward of the largest rock of Volunteer Point; or, Uranie Rock bears N. by W. ¼ W., and distant 9½ miles from the light on Pembroke Point. Wolf Rock bears S. 7° W. from the light-house. Vessels in entering Port William should leave the light on the port hand, and

as the flood current sets strong to the northward, while the ebb sets to the southward, a bright lookout must be kept when doubling the cape, so as to pass between it and the Seal Rocks, which lie to the northward and eastward, and about $\frac{3}{4}$ of a mile distant; this applies to steamers, or to sailing-vessels standing in with a free wind; generally, when the breeze is light, or the swell considerable, it is best to pass off shore of them.

All the bearings given are magnetic. The variation was 15° 30′ easterly in 1871, and decreases 4′ annually. Port Stanley is a free port. Good water and fresh provisions, &c., are to be found there, as also ship's stores and pit-coal; the establishment of the port is $5^h\ 30^m$; the height of the tide varies from $5\frac{1}{2}$ to 7 feet; neap range, 4 feet. The observation spot of Stanley Harbor is in 51° 41′ 10″ S., and 57° 51′ 30″ W. of Greenwich.

We now proceed to give a table of the best points of crossings, according to the season, between 50° S. and the equator. These crossings are chosen in such a way as to carry vessels through those parts of the ocean where the winds are most favorable, and the fewest number of calms are to be found. After this table, and, as we have already done in preceding sections, we shall study each route successively in detail, and shall indicate the chances which may be expected in following them.

Route when returning from the Pacific Ocean, from 50° S. to the line.

Season.	South latitudes.											Month.
	50°	45°	40°	35°	30°	25°	20°	15°	10°	5°	0°	
	W. long.	W. long.	W. long.	W. long.	W. long.	W. long.	W. long.	W. long.	W. long.	W. long.	W. long.	
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	
January, February, and March	50 10	39 24	29 24	19 25	15 00	12 40	13 40	16 20	19 06	21 48	24 30	Jan.
											24 00	Feb.
											24 30	Mar.
April, May, and June	52 48	45 00	35 00	25 00	20 00	17 30	17 30	18 55	20 30	22 00	24 00	Apr.
											24 00	May.
											23 00	June.
July, August, and September	54 18	48 24	40 00	35 00	27 30	24 00	23 10	24 30	22 24	21 15	21 00	July.
											20 30	Aug.
											21 50	Sept.
October, November, and December	44 30	29 20	15 00	7 30	7 30	7 30	7 30	11 12	15 00	18 40	22 40	Oct.
											22 10	Nov.
											23 40	Dec.

In *January*, *February*, and *March*, when following the route as given in the preceding table, for this season of the year, to the northward of 50° S., and between the meridians of 45° and 50° W., the winds will be found to predominate from NW. and WNW., blowing occasionally from SSW. and NNE. In case a series of the last-named winds are encountered, which, by the way, is very rare indeed, the port tack should be taken, with the ship's head to the eastward. After having crossed the meridian of 38° W. at about 45° S., the winds may be expected to pre-

dominate from NW., W., SW., and S., with a few occasional easterly breezes, and a NNE. course may be made on the starboard tack.

To the northward of the parallel of 45° N., and between the meridians of 35° and 40° W., N., NW., W., SW., and S., winds will be found; all of these, except those from the northward, will be favorable. With N. winds the port tack must be taken, and a ENE. course may be run. The meridian of 35° W. may be easily reached at 43° S., and the course may be continued, with the winds constantly from N., NW., and W., so as to cross 40° S. at 29° 24′ W. To the northward of the parallel of 40° S., and between the meridians of 25° and 30° W., the winds predominate from N. and NW.; there are, however, some few chances in favor of W., SW., and S. winds, and also of an occasional breeze from between SE. and E.

In case of encountering E. winds, which are exceedingly rare, a NNE. course should be made by taking the starboard tack. However, the meridian of 25° W. should be cut before reaching 37° S. Between the meridians of 25° and 20° W., the winds will predominate from N. to NW., and W. and SW.; there may also be a few occasional NE. winds, which, however, will be of short duration, and with their help an ESE. course may be made on the port tack. To the northward of the parallel of 35° S., which should, if possible, be crossed between 19° 10′ and 20° W., the winds will predominate from N. to NW., SW., S., and SE.; that is, will be very favorable, and will blow but very rarely from the NE. In this latter case, the starboard tack should be taken, with the head NNW., and no time should be lost in getting on the other tack when the wind hauls, as it will very quickly, to the N. and NW. The parallel of 30° S. should not be crossed any farther to the eastward than the meridian of 15° W., because to the eastward of it, and between 30° and 35° S., the winds are not any more favorable, and there are about 8 per cent. of calms to be overcome. We also recommend to avoid crossing 30° S. much to the westward of 15° W., because, otherwise vessels will fall into the zone comprised between 25° and 36° S. and 15° and 20 W., where there are from 27 to 30 per cent. of NE. winds On the other hand, between these same parallels, but between the meridians of 15° and 10° W., there are only 16 per cent. of chances in favor of NE. winds, and the same in favor of N. winds. With those from NE. a course must be made on the starboard tack, and with those from N. on the port tack. The N. winds will then haul through W. and SW., almost to SE., which will be the prevailing direction. The *trade zone* will generally be entered at about 27° S. and W. 14°.

Between the parallels of 20° and 25° S., and the meridians of 10° and 15° W., the trades will be encountered, varying from W. to S., SE., and E.; the wind will blow about 45 per cent. of the time from SE., and 25 per cent. from E. Nothing can be easier, then, than crossing 20° S. at 14° W. From this point the trades will be perfectly established, blowing constantly from SE., and with them vessels may run

directly for the proposed point for crossing the line. The best points at which this may be done are given in Route from the Equater to France, p. 78, From the Line to New York p. 94, and of the North Atlantic instructions. Those given in the preceding table are for vessels bound to Europe. When bound to the United States the line should be crossed, in this season, at about 30° W.

Vessels proposing to call at Saint Helena will have the same chances of wind and weather as those whose route we have just described. They should cross 30° S. at 15° W.; 25° S. at 11° 48′ W.; and from there steer directly for the island, with winds from SE., varying from S. to E., as far as 20° S., which should be crossed at 8° W. They will then have the trades free. When leaving Saint Helena they should make a direct course, with the wind almost astern, so as to cross the equator at the points already indicated.

In *April*, *May*, and *June*, after doubling the Horn, 56° S. should generally be crossed between 64° and 65° W., and 55° S. at 60° W. To the northward of this latter parallel, and between the meridians of 55° and 60° W., the winds will still be very favorable, and will predominate from NW. to WSW. There will, however, be about 12 per cent. of chances of NNE. winds; and in case a series of these winds are met with, it must be understood that an E. or E. ¼ S. course, if necessary, may be made without exciting any anxiety. In ordinary weather, 52° 30′ S. should be crossed at 55° W.; but, we repeat, that if by chance NNE. winds are encountered, the meridian of 55° W. may be cut much farther to the southward—at 53°, or even 53° 30′ S.—without the least inconvenience. After having passed to the eastward of the meridian of 55° W., the winds will be favorable all the time; that is from NNW. to WSW., and ocasionally from SSE., with which, as a general thing it will be easy to cross 50° S. at 52° 48′ W., and 47° S. at 50° W. In case of encountering a persistent series of NNW. winds, vessels may be forced to cross the meridian of 50° W. farther to the southward than 47° S.; this will be a very unfavorable circumstance, as we shall proceed to point out.

The chances of weather which may be counted on between 45° and 50° S., and from 50° to 45° W., are as follows: 16 per cent. of NE.; 19 per cent. of NNW.; 23 per cent. of W.; 26 per cent. of SW.; and 10 per cent. of SE. winds, as also 5 or 6 per cent. of calms; that is to say, to the eastward of the meridian of 50° W., there will be about 35 per cent. of winds between NE. and NNW. Accordingly, when about to enter this zone, vessels will be in a better position the nearer they are to the parallel of 47° or even 46° 30′ S., for they will then be well to windward, and may easily run to cross 45° S. at 45° W. At this place we shall remark (see Zones of calms, p. 101) that there are two unfavorable zones, containing 9 per cent. of calms, and lying, first, between the parallels of 45° and 50° S., and the meridians of 40° and 45° W., and second, between the parallels of 40° and 45° S. and the meridians of 45°

and 50° W. These two zones may be avoided by crossing, as we have already said, the parallel of 45° S. at the meridian of 45° W.

From this point a course should be steered to cross 42° 30′ S. at 40° W. In this small fraction of the voyage, to the northward of 45° S. and between 45° and 40° W., there will be 11 per cent. of chances of NE.; 27 per cent. of NW.; 21 per cent. of W.; 23 per cent. of SW.; and 15 per cent. of S. winds, as also 3 per cent. of calms; that is to say, there will be 86 per cent. of favorable and only 14 per cent. of unfavorable weather, which will consist of the chances of NE. winds and the calms. It will be best then to profit by the winds, which are nearly always from the westward, by steering to cross 44° at 43° 30′ or 44° W., and 43° S. at 44° 30′ W. In this way a better position will be obtained in case the wind hauls to NE., when the port tack may be taken, heading ESE., without any inconvenience; because in this case vessels will be farther away from the parallel of 45° S., to the southward of which there is a much less favorable zone; and, also, because the easterly tack will at least gain easting, while the other will lead to the NNW. Now it is always better to get to the eastward of the meridian of 40° W., as beyond it the chances are most favorable.

As a general thing the meridian of 40° W. ought to be crossed at 42° 30′ S.; the winds will then be found from the northward, NW. and SW., with which it will be very easy to cross 40° S. at 35° W. However, if a series of northerly winds are encountered, and in such a case it must be understood that the port tack should be taken, it may be necessary to cross 40° S. farther to the eastward, which will have no other inconvenience than that of lengthening the voyage a very little. At no time should 40° S. be crossed to the westward of the meridian of 35° W., as in that case a zone containing 6 per cent. of calms will be entered, and, besides that, the route will not be shortened by it, because it will then be necessary to run to cross 35° S. at 25° W. There is nothing to be said about the route between 40° and 35° S.; the winds will always be favorable there, blowing from NW. to SW.

From 35° S., crossed at 25° W., the course should be laid to cross 30° S. at 20° W. In this part of the route there will be 17 per cent. of chances of NNE.; 30 per cent. of NNW.; 12 per cent. of W.; 13 per cent. of SW., and 28 per cent. of SSE. winds, without any calms at all. The winds then will always be favorable, except for about 17 per cent. of the time, when they may blow from NNE. In case these are encountered before the parallel of 33° S. is reached, the port tack should be taken, heading to E. or ESE. On the other hand, if the wind hauls to the NE., after the parallel of 33° S. has been passed, the starboard tack, heading NNW. or even NW., should be preferred. In either case the true route may be approximated by luffing or going on the other tack as the wind hauls, so as to cross 30° S. somewhere in the vicinity of 20° W. Finally, in case the wind hauls to NE., after having crossed 31° 30′ S. at 21° 20′ W., it will be most advantageous to take the port

tack and to stand to the eastward, as by so doing a vessel increases the distance from the unfavorable zone comprised between 25° and 30° S. and 20° and 25° W., where the winds predominate from E., NE., and N. It will always be better then to cross 30° S. rather to the eastward than to the westward of the meridian of 20° W.

After having passed 30° S., the course should be laid to cross 27° 30′ S. at 17° 30′ W., and then to stand directly N. as far as 20° S. Between 30° and 25° S., the winds will predominate from NW. to SW., blowing occasionally from NE. and SE. They will all be favorable except those from NE., which will require the port tack to be taken; that is, provided they are encountered before reaching the meridian of 18° 10′ W. When this last meridian is reached, if the NE. wind is persistent, the other tack, heading NNW., must be taken, but without passing to the westward of 19° W. If the NE. wind still continues to blow when that meridian is reached, the port tack should again be taken.

To the northward of the parallel of 25° N., when running the due N. course, the winds will be variable from SW. to S. and SE., with which a very good run may be made. Finally, upon reaching the parallel of 22° or 20° S., the steady trades will be entered, and the points of crossing as indicated in the table may then be followed. The course to the line will then be such that the wind will be well quartering.

The points at which the line is to be crossed, as given in the table, are intended for vessels bound to Europe. When bound to the United States, it should be crossed at 31° 10′ W., in this season, as was said in The Line to New York, p 94, of the instructions for the North Atlantic.

Those vessels which are obliged to make a call at Saint Helena should follow exactly the same route, as far as the parallel of 30° S., which should be crossed near 20° W. From there they should steer, with winds generally from NW. to SW., and occasionally from NE. and SE., so as to cross 25° S. at about 15° W. If the NE. winds are met with before the meridian of 19° W. is reached, the port tack should be taken. Beyond this meridian the starboard tacks must be brought aboard, with NE. winds; but, at the same time, the meridian of 19° W. must not be passed again; that is to say, if when reaching that meridian on the starboard tack the NE. winds still continue persistent, the port tack should again be taken. In case the wind hauls to NE. after the meridian of 18° or 17° W. is crossed at 28° or 27° S., not a moment should be lost in getting on the starboard tack.

As a general thing, it will be very easy for vessels bound to Saint Helena to cross 25° S. at 15° W.; and, from this point, the SE. trades will be found, and with them the studding-sails may be set, and a splendid run made. Leaving Saint Helena, the course should be directly for the point at which it is proposed to cross the equator, and may be run with a good free wind. In the case of vessels bound to Europe, the whole distance to be made will be increased about 720

miles by calling at Saint Helena at this season of the year; but for those bound to the United States it will be increased 840 miles. In the first case, this will make the voyage about 5 days longer in time, and in the second case, about 7 days. With these facts before us, we may see that a call there should only be made in cases of actual necessity.

In *July*, *August*, and *September*, after having doubled the Horn, the course should be laid so as to cross 56° S. at 65° W.; 55° S. at 62° 30′ W.; 52° 30′ S. at 57° 30′ W., and 50° S. at 54° 18′ W. This route may be easily followed, as the winds will be from WNW. to SW. as far as the parallel of 53° 50′ S., which should be crossed at 60° W.; to the eastward of this meridian it is not the same; the prevailing winds will then be from NNW. to WNW. and SW., but there will also be 11 per cent. of chances of ENE., and 14 or 15 per cent. of chances of NNE. winds. In case these contrary winds are encountered, it will evidently be impossible to conform to the indicated route. It will be necessary, with ENE. winds, to run to the northward if the Falklands are not too close aboard, or else to take the port tack, heading SE. When the wind hauls to NNE. the port tack should immediately be taken so as to head to the eastward; at least this should be done, provided the wind had previously been from ENE.; and then after having made sufficient easting, a good position will be obtained for running a course to the NW. on the starboard tack. Although the chances of ENE. and NNE. winds taken together only amount to 25 or 26 per cent. it is not the less necessary to provide against the possibility of being obliged to pass the meridian of 55° W. at 52° 30′ or 53° S.

When forced by a series of NE. to NNE. winds to enter the square comprised between 50° and 55° S., and between 55° and 50° W., the following chances of weather may be expected: 15 per cent. of NNE.; 39 per cent. of NNW.; 15 per cent. of WSW.; and 29 per cent. of SW. winds, and also 2 per cent. of calms. The contrary winds, viz, from NNE. to NNW., blow about 54 per cent. of the time in this zone, which, for that reason, is very unfavorable.

We will conclude by saying, as a general thing the parallel of 50° S. may be crossed at 54° 18′ W., as we have already said; but it may happen that the circumstances of the weather may force a crossing much farther to the eastward; in which case one is in a much worse position for following the route recommended.

Between the parallels of 50° and 45° S., the meridian of 50° W. separates two very distinct zones. The western one, between the meridians of 50° and 55° W., is favorable; the winds in it blow constantly from NNW. to SSW. through W., with which the parallel of 46° S. may generally be crossed at 50° W. (that is, after 50° S. has been crossed at 54° 18′ W). The eastern zone, between the meridians of 50° and 45° W., is less favorable. In it will be found some 20 per cent. of N. winds, and the rest from NW., W., and SW. Finally, when still farther to

the eastward than the meridian of 45° W., the chances in favor of north winds are still greater.

Between the parallels of 45° and 40° S., when sailing the route we advise, the following crossings will successively be made: 45° S. at 48° 24′ W.; 42° 30′ S. at 45° W.; and 40° S. at 40° W. Vessels which can conform pretty closely to these points of crossing will have the winds persistent from N., NW., W., and SW., when between 45° and 42° 30′ S. (with a few very rare chances of NE. breezes); they will then find the winds varying successively from the N. to WNW., SW., S., and ESE., between 42° 30′ and 40° S. (with a few very rare chances of NE. breezes). This route we believe to be by far the best one to follow.

As we have already said, it may be that a series of head winds previously encountered may have required a vessel to cross 45° S. at a point a great deal to the eastward of 48° 24′ W.; for example, between 43° and 45° W. We again recommend, in such a case, making a course to cross 40 S. at 40° W., for which the winds will be favorable. But if northerly winds are experienced, the port tack should be taken without hesitation, as there will be every advantage in making an ENE. course, since in that way will be reached the favorable zone lying between 35° and 40° W., in which the winds blow constantly from NW. to S. through W.

Thus, no matter what weather may have been experienced in the first part of the route, we may regard it as certain that all vessels may cross 40° S. at 40° W.

Between 40° and 35° S. the meridian of 35° W. separates two very different zones. The western one, comprised between 35° and 40° W., is favorable. The prevailing wind found there is from SW., that is to say, astern; but we may also count on winds from N., NW., W., S., SE., and E. None of these are really contrary, and after having reached 40° S. at 40° W., as we have advised, the port tack may be taken with north winds, and it is probable that the wind will haul fair before the meridian of 35° W. is reached, so as to allow a course to be steered, with the NW. and W. winds, which shall cross 35° S. at 35° W. The eastern zone, between 30° and 35° W., into which no vessel should enter, is very bad, because the wind blows there about 25 per cent. of the time from the NE. (that is to say, right ahead); 19 per cent. from the N. (which is little better); 10 per cent. from the NW.; 21 per cent. from the W.; 17 per cent. from the SW., and 8 per cent. from the SE. The conclusion to be arrived at from this discussion is, that it will be necessary to cross the parallel of 35° S. at 35° W.

Between 35° S., crossed at 35° W., and 30° S., crossed at 27° 30′ W., the course as traced on the chart is N. 51° E. (true), and it will generally be possible to make this with the variable winds, though N. and NW. winds must be expected to predominate. With this in view, the precaution should be taken of always keeping a little to the northward the route, when the westerly and southerly winds will permit; and this

to avoid being thrown too far to leeward, in case of encountering a series of NE. to NW. winds. However, when leaving the parallel of 35° S., the simple proposition should be to run to cross the parallel of 25° S. between the meridians of 20° and 25° W., and if possible at 24° W., but without sailing too close to the wind to do it. The chances of winds which may be counted on, and in regard to which the route should be regulated, are as follows:

Between 35° and 30° S., and from 30° to 25° W., there will be 9 per cent. of NE.; 24 per cent. of N.; 20 per cent. of NW.; 19 per cent. of SW.; 15 per cent. of S., and 10 per cent. of SE. winds, as also 3 per cent. of calms.

Between 35° and 30° S., and from 35° to 30° W., there will be 16 per cent. of NE.; 26 per cent. of N.; 12 per cent. of NW.; 7 per cent. of SW., 10 per cent. of S.; 12 per cent. of SE., and 14 per cent. of E. winds, as also 3 per cent. of calms.

Between 30° and 25° S., and from 30° to 25° W., we may count on 20 per cent. of SE.; 28 per cent. of E.; 20 per cent. of NE.; 18 per cent. of N., and 10 per cent. of NW. winds, and 4 per cent. of calms.

Between 30° and 25° S., and from 25° to 20° W., there will be 14 per cent. of SE.; 16 per cent. of NE.; 19 per cent. of N.; 16 per cent. of NW.; 12 per cent. of SW., and 21 per cent. of S. winds, and 2 per cent. of calms.

After reaching 25° S., between 20° and 25° W., it will generally be very easy to make a N. ½ E. course, with the following chances of weather: 43 per cent. of E.; 35 per cent. of SE., and 18 per cent. of NE. winds, and about 4 per cent. of calms. (See Southeast Trade winds, p. 103.) The trades will be found well established from SE. to E., about the parallel of 23° S., which should be crossed at 23° or 24° W. Then the points of crossing as indicated inthe table may be followed up to the line.

We have already said that a call at Montevideo presents, among other inconveniences, the likelihood of having to ride out a pampero, and that the latter are to be feared, particularly in July, August, and September. We should also add, that in this season (meaning the one we have just been writing about) the call at Saint Helena will lengthen the voyage, from the Horn to the line, about 800 miles. This very large increase only takes place in July, August, and September; the direct route as indicated by us being in these months much farther to the westward, and consequently much shorter than at any other season of the year.

Vessels which are obliged to call at Saint Helena will have to follow a route totally different in all its parts from the one already given. After having doubled the Horn, they will profit by the heavy westerly winds and run to the eastward, making all their longitude in the high latitudes where the degrees are short. They will then run to cross 50° S. at 38° W., and 45° S. at 15° W.; during this part of the voyage a

bright lookout must be kept for icebergs. If the parallel of 45° S. should be crossed to the westward of the meridian of 15° W., they will be exposed to a series of very persistent NE. and NW. winds. On the other hand, by taking the precaution of not crossing 45° S. to the westward of 15° or 14° 30′ W., the winds will be fresh and will haul from NW. to W., SW. and SE., so there will be every facility afforded for making a quick run to cross 40° S. at 12° 30′ W., and 35° S. at 10° W. From this point a course should be steered to cross 29° or 30° S. at the meridian of Saint Helena, and then the rest of the voyage may be made with the SE. trade winds. When following this route, a few head winds may be encountered, but only when between the parallels of 35° and 30° S., and to the eastward of the meridian of 10° W., where the winds nearly always blow favorable, viz, from NW., SW., or SE.; but where they are sometimes interrupted by NE. or contrary winds. The only objection to this route is the danger of ice, and the very heavy westerly weather to which vessels are exposed when between 55° and 45° S. But if it is necessary to call at Saint Helena, and an intermediate route, between the one direct from the Horn to the line and the southern one just given, is chosen, vessels cannot count upon a good run, although by chance one may be made; and, besides that, there is every likelihood of being delayed, when between 25° and 35° S., by NE. and northerly winds. By taking the southern route and stopping at Saint Helena, the time spent at sea will be about a week longer than when going by the direct route from the Horn to the line.

All that we have said about the route from the Horn to the line in July, August, and September, in regard to vessels bound to Europe, is also applicable to vessels bound to the United States. However, it must be understood that after entering the trades the course must be laid to cross 5° N. at 27° 30′ W., as was pointed out in From the line to New York, p. 94, of the instructions for navigating the North Atlantic Ocean.

In *October*, *November*, and *December:* The route we advise for this is altogether different from that of any other season, and comprises a small *détour* which has to be made, and which we will first explain with a few remarks.

When examining the pilot charts for the months of October, November, and December, we are struck by the frequency of the N. and NE. winds in that part of the South Atlantic comprised between the parallels of 20° and 40° S. and the meridians of 10° and 40° W. Thus, between 20° and 25° S., and from 10° to 15° W., there are 71 per cent. of N. and 24 per cent. of NE. winds. From 15° to 20° W., there are 24 per cent. of NE. winds; between 20° and 25° W., there are 24 per cent. of NE. winds; between 25° and 30° W., there are 21 per cent. of N. and 21 per cent. of NE. winds.

Between 25° and 30° S., and from 20° to 25° W., there are 19 per cent. of N. and 26° per cent. of NE. winds; from 25° to 30° W., there are 25

per cent. of N. and 25 per cent. of NE. winds; from 30° to 35° W., there are 22 per cent. of N. and 30 per cent. of NE. winds; and finally, from 35° to 40° W., there are 40 per cent. of N. and 30 per cent. of NE. winds.

Even between 30° and 35° S., and from 20° to 25° W., there are 23 per cent. of N. and 10 per cent. of NE. winds. From 25° to 30° W., there are 20° per cent. of N. and 10 per cent. of NE. winds; and from 30° to 35° W., there are 25 per cent. of N. and 24 per cent. of NE. winds.

Finally, between 35° and 40° S., and from 15° to 20° W., there are 30 per cent. of N. winds; and from 20° to 25° W., there are also 26 per cent. of N. winds.

From these remarks we may see that vessels leaving the Horn, and endeavoring to make an almost direct course to the line, by crossing 40° S. in the vicinity of 40° W., and 25° S. at 25° W., may sometimes make a very fine passage, but they will all be exposed to great delay in gaining the trade zone by the head winds which will be encountered. It therefore seems to us preferable to follow the points of crossing as given in the table at the beginning of this section; this route is from 700 to 800 miles longer than the direct one, but it may be run, on an average, in a much shorter time.*

From the Horn to 44° or 43° 30′ S., which should be crossed between 25° and 26° W., a distance of 150 to 250 miles may be made daily, with the wind quartering, and favored by the winds and sea. A bright lookout must be kept for icebergs during all this part of the voyage.

The course should be made, with the strong winds, which vary from NW. to SW., as far as the parallel of 40° S., which should never be crossed to the westward of 15° W.

Between 40° S., crossed at about 15° W., and 38° S., which should be crossed at 10° W., the winds will be very favorable, blowing steadily from NW. to SW.

However, a series of NE. breezes may be accidentally encountered, but with them the starboard tack should be taken, with head to the NNW.; but at the same time we must say that this course should not be kept when it will lead to the westward of 15° W. As soon as the wind hauls to the NNE. and N., the other tack should immediately be taken, so as to head E. and ENE., coming up to the course gradually as the wind hauls to the NW. and SW.

After having arrived at the parallel of 37° 30′ S., crossed at 9° 25′ W., the winds will continue to predominate from NW. to SW., occasionally veering round the compass, blowing at times from SE., ESE., and NE. The principal rule to be followed when in this locality is to make northing as soon as possible, with very little easting, in such a way as to touch the meridian of 5° W., and then to endeavor to stand

* It is well to remark that the difference of 700 to 800 miles, in favor of the direct route, is, in reality, very sensibly diminished by the tacks forced to be taken by headwinds on that route.

on in the vicinity of that meridian to 20° S. This parallel may be crossed at 9° W., but never any farther to the westward. We shall insist, at this place, on the necessity of not approaching too close to 10° W. when between the parallels of 36° and 20° S., because the zones lying to the westward of it are very unfavorable, on account of the calms and NE. and NW. winds.

Having arrived at the parallel of 20° S., crossed between 7° 30′ and 9° W., there is nothing more to be done except to make a course, with a free wind on the starboard beam, for the point at which the equator is to be crossed. This point, of course, varies according to the month in which it is passed. The points are given in the preceding table for vessels bound to Europe; those bound to the United States should cross at 30° W., as was said in From the line to New York, p. 94, of the instructions for the navigation of the North Atlantic Ocean.

The call at Saint Helena is the only one to be thought of in this season, looking at the slight increase in length of the voyage, which in this case is only 300 miles in distance, or about two days in time. All that has been previously said in regard to vessels going directly to the line applies also to those which propose to call at Saint Helena. The latter should cross 30° S. at 7° 30′ W., and should make a direct route from this point, with well-established SE. trade winds.

Doubling Cape Horn from east to west.—Whenever a question is very important, and very great interests depend upon its solution, we are always sure to find great differences among the various authors whom we consult in regard to it; and sometimes the advice they give is exactly opposite. This will be found to be the case in almost every instance. As a proof we will cite a few authorities on the route now under consideration.

Captain King, in his instructions for reaching Cape Horn, recommends following the east coast of Patagonia. Fitz-Roy sets forth a different opinion. King says the Straits of Le Maire are exceedingly dangerous for sailing vessels. Fitz-Roy says there is no danger whatever in navigating them. Fitz-Roy recommends passing close to the land when doubling Cape Horn. Weddel advises going as far south as 60° in the winter time. We have already shown the differences of opinion as to the value of the barometric indications off the Horn. We will end by citing the instructions of Kerhallet, in which we will find that icebergs are most to be feared, when off the Horn, in the months of July, August, and September; while, according to Maury, they are most abundant from November to April.

We shall proceed to give a *résumé* of the principal instructions of the most distinguished authors; and, in doing so, we shall first quote from King and Fitz-Roy.

Captain King advises vessels to keep well off shore when doubling Staten Island. He thinks it would be imprudent to attempt the Straits of Le Maire with southerly winds; because, when the tide sets to windward, the sea becomes very heavy across it, and may seriously endanger

to small vessels, while it is sufficient to cause rather heavy damages to the larger ones. In calm weather it will be still more dangerous to be caught in the straits, as the currents set toward Staten Island; and, consequently, it may become necessary to anchor, and this can only be done in very deep water, and then quite close to the shore. But, with northerly winds, this route gains so much to the westward that it will rarely be avoided; however, it is always doubtful whether northerly winds, unless they are very strong, will blow through the whole length of the straits; and, if they die out, there is great danger of being driven on to the eastern shore. Captain Fitz-Roy seems to think there is no danger whatever in taking the Straits of Le Maire. The principal danger, if there is any, is that the winds may die out. Vessels coming from the southward will not lose the SW. wind, except when it is very feeble; and then, as a general thing, they will find NW. winds at the northern end of the straits.*

The anchorage in Good Success Bay, on the western coast of the straits, is admirably situated in case the tide is adverse.

When it is decided to pass to leeward of Staten Island a lookout must be kept for the tide-race, which extends quite a distance off Cape Saint John on the NE. extremity of the island. There are no other dangers, however, to be feared. The passage by Nassau Bay cannot be recommended.

After having doubled the island to the eastward, if the wind blows from nearer S. than SSW., the port tack should be taken; but if it blows from the westward, the starboard tack should be taken, and a course may be run as far as 60° S., about which many navigators think the wind predominates from the eastward.† That tack which makes the most westing should then be taken. After having arrived at the meridian of Cape Pillar, or of 75° W., every effort to make on the route should still be continued as far as 83° or 84° W.; this will then allow northing to be made in spite of the NW. winds, which prevail between 50° and 54° S.

In regard to the seasons and the choice of time in which to double Cape Horn, Captain King, in spite of the advantage of longer days in the southern summer, thinks it preferable to make the passage *during the southern winter.* According to him, the E. and N. winds are frequent in that season, while W. and S. winds prevail in summer. Further, the winds are moderate in winter, when compared with the furious summer gales.

In the same instructions the following observations may be found:

The equinoctial months, particularly March, are the very worst, and the gales of wind very violent. August, September, and October are the coldest; rain, snow, and

* It will be remarked that in this citation from Fitz-Roy he only speaks of vessels coming from the Pacific. Now, no one has ever doubted the facility of that passage for them. His instructions do not speak of vessels bound the other way.

† The pilot-charts do not mention this. The prevailing winds off Cape Horn are those from NW. to SW., and easterly winds are very rare; this is so particularly about this parallel of 60° S., and especially in winter.

sleet. December, January, and February are the warmest; the days are longest, and sometimes the weather is quite fine; but the westerly winds are more frequent, at times very strong, and accompanied by heavy rains. In April, May, and June there is less bad weather than at any other season; easterly winds are frequent, and now and then bring rather steady fine weather. June and July resemble each other very much, but the heavy easterly winds are more frequent in July. The conclusion is that the months of June and July, although very cold, and in spite of the shortness of the days, are perhaps the most favorable for doubling Cape Horn from E. to W.; the months of April and May are also rather favorable for making the same voyage. Finally, the months of December and January are the best for making the passage when returning from the Pacific.

We shall give the opinion of Capt. J. Weddel, R. N. It will be remarked that these instructions do not fully agree with the preceding ones. The following is a *résumé:*

March and April are the worst months in which to double the Horn from E. to W. On the contrary, the passage will be quite easy from the 1st of November to the 15th of February, the period in which the winds do not often blow from the westward. From the 20th of February to about the 15th of May, there are very violent winds from NW. to SW.; consequently, it is almost impossible to double the cape, at least without running great risks, in a light-built vessel, or one that is but a medium sailer. From the 15th of May to the last of June, the winds predominate from the eastward, with fine weather. The cape may be doubled, at this season, by passing in sight of Diego-Ramirez. In July, August, September, and October, the winds are from NW. to SW., and tempests are frequent in August and September.

Captain Weddel also advises taking the Straits of Le Maire in summer, because it shortens the route some 50 or 60 miles, and because they may be taken without danger, provided there is a certainty of having daylight enough to get out in case of encountering head winds at the southern extremity. When leaving the straits, the route should be to the southward to pass around the Horn; then coast along to the westward, and pass to the southward of Diego Ramirez Island, at a distance of a few miles. In summer, when working to the westward, vessels should get near the coast of Tierra del Fuego in the evening, because the wind frequently hauls to the northward at night, and to the westward again in the morning.

In the bad-weather months, March, August, and September, according to Weddel, Anson, and King, it is necessary to stand to the southward to 60° S. latitude, where the sea will be more regular, and the winds more steady, both in force and direction.

Captain King advises vessels bound to the Pacific to keep close along the E. coast of Patagonia, at a distance of 100 miles. We have already mentioned the advantages of this route in Route from the line to the Pacific Ocean, p. 141. Fitz-Roy is of a slightly different opinion. It is true, he says, that the sea is much smoother near the land, and that there is less fear of ice than farther off shore; but nevertheless, as the currents set to the northward with much greater force in-shore, it is better for large and well-constructed vessels to remain farther seaward.

In regard to doubling the cape Fitz-Roy thinks that, instead of descending to 60° S., as King recommends, it is preferable to beat near Tierra del Fuego, toward the bay of Nassau; he advises, in case of

heavy weather, to anchor in the bay of Orange, under Noire Island, in Euston Bay, and sometimes elsewhere, and to seize the first favorable occasion that presents itself to make a good course to the westward, as far as the meridian of 82° W.

Captain Beechey thinks, with Fitz-Roy, that it is useless to run to the southward in order to double Cape Horn. He only recommends taking that tack which gains most to the westward, by working within 60 miles to the southward of the cape. With the winds from SW. a course should be made to the NW., and with those from NW. one to the SW.; finally, if the two tacks are equally unfavorable, the southern tack should be taken, at least if a high latitude shall not have already been reached. In all cases great care should be used not to approach the coast to the eastward of the Horn, on account of the danger incurred by the velocity of the current across the Straits of Le Maire, and particularly with southerly winds. To the westward of Diego Ramirez Island the shore may be approached with impunity to within 40 or 60 miles.

Weddel also advises going as far S. as 60° in winter, and the rest of the time keeping nearer the land. Fitz-Roy thinks the coast should be kept quite close aboard. Beechey, in his turn, advises keeping away from the coast to the eastward of the Horn, but approaching it when to the westward of Diego Ramirez Island.

In the presence of these different opinions it is very difficult for the navigator to decide with which one to agree. In all cases, and no matter which route may be chosen, there will be some one in favor and some one against it.

We shall now revert to the instructions of Maury, and will commence by extracting a table of mean passages, for each month of the year, between the parallel of 50° S. in the Atlantic to 50° S. in the Pacific:

Mean routes for doubling Cape Horn.

Months.	No. of days from Saint Roque to 50° south.	Longitudes for intersecting (to the eastward of Cape Horn) the parallels of—			Latitudes for intersecting (to the southward of Cape Horn) the meridians of—			Longitudes for intersecting (to the westward of Cape Horn) the parallels of—			From 50° S. in the Atlantic to 50° S. in the Pacific.
		50° S.	53° S.	56° S.	67° W.	71° W.	75° W.	55° S.	53° S.	50° S.	
		W. long.*	W. long.*	W. long.*	S. lat.	S. lat.	S. lat.	W. long.*	W. long.*	W. long.*	
	Days.	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	*Days.*
January	24. 6	63 04	64 16	65 16	56 54	57 24	56 42	79 16	79 46	79 40	16. 0
February	27. 3	63 22	64 10	65 22	56 48	57 18	56 54	77 40	78 46	80 28	16. 1
March	27. 3	64 16	63 40	64 16	56 30	57 00	56 30	77 22	77 52	81 28	18. 3
April	31. 4	60 52	62 58	65 58	56 30	56 48	56 24	77 58	80 28	81 40	16. 4
May	29. 7	63 40	64 22	65 10	56 42	57 18	56 54	78 16	79 28	80 40	19. 0
June	29. 5	63 16	63 40	64 22	57 00	57 18	56 42	77 22	78 16	81 58	15. 7
July	29. 3	60 52	60 22	64 04	57 00	57 00	56 00	77 16	79 16	80 28	19. 5
August	32. 5	62 58	64 16	64 16	56 48	57 06	56 18	77 10	79 40	81 34	17. 9
September	26. 4	63 52	64 40	65 22	56 36	57 00	57 00	78 46	80 58	82 04	20. 9
October	25. 6	64 16	64 28	66 22	56 12	56 18	57 18	79 04	80 40	81 58	19. 5
November	24. 3	62 58	64 28	64 46	56 42	57 12	57 06	76 58	79 04	79 40	20. 6
December	25. 3	62 46	63 52	65 04	57 24	57 00	56 00	77 16	79 10	80 22	15. 3

* From Greenwich.

In the first place this table allows us to establish the order of preference of the most advantageous months to run from Cape Saint Roque to the parallel of 50° S. in the Pacific. When Saint Roque is doubled in November, 50° S. in the Pacific will be reached in 39.6 days. This is the most favorable season.

In January to February, it will take 40.7 days; in December to January, 41.3 days; in March to April, 43.7 days; in May to June, 45.4 days; in February to March, 45.6 days; in September to October, 45.9 days; in October to November, 46.2 days; in July to August, 46.3 days; in June to July, 49 days; in April to May, 50.4 days, and in August to September, 53.4 days, which last is the worst season of the year.

To sum up, the best season for doubling Cape Horn, with regard to the time of passage, is from December to April inclusive, and the worst season is from June to November. This is the result obtained by Maury, from a mean of 220 passages, and may therefore be regarded as absolutely correct, and as going far beyond the speculations of a single navigator who reasons from what has been experienced in about a dozen voyages at the most.

These irrefutable results of the averages as made by Maury almost completely destroy the opinion or advice as given by King, in which he says that the months of April, May, June, and July are the most favorable for doubling the cape; on the contrary, they seem to confirm the views of Captain Weddel, which have already been given.

There will also be found in Maury's instructions a letter addressed to him by Captain Smyley, which contains some very interesting remarks upon the incontestable advantages of the passage in-shore of the Falklands. It says:

For a long time it has been the custom for vessels when bound to the Pacific, after crossing the parallel of the river Plata, to steer to pass to the eastward of the Falklands; some in order to avoid running by *l'Aigle* Shoal, others fearing to get *jammed* on the coast of Patagonia. This should no longer be an excuse, for the first does not exist and of the latter there is no danger. I have cruised for the above-mentioned shoal several times, taking a good departure from the Jasans and from New Island, in the Falklands, and crossed to Cape Virgins and back in the long summer days, seeing no signs of it.

As for vessels getting blown on shore on the coast of Patagonia by northeast gales, it is out of the question. I have spent twenty-two years of my life mostly between the South Shetlands to the river Plata, and once I remained six years without coming north of 41° S., and I cannot say that I ever knew the wind to blow heavily directly on shore for twelve consecutive hours. My voyages being principally for sealing or whaling caused me to keep close into the coast, whereby I had the best opportunities for observing the weather, currents, tides, &c.; in fact, my voyages depended partly on these, and it stood me in hand to make myself acquainted with them. [See the above letter in full, page 465, Maury's Sailing Directions, eighth edition, vol. ii.]

We shall finish our quotations by giving the advice of Maury, which seems to us to include everything that is good in the different authors, and which has the very great advantage of being based on a large number of observations:

The rule will be to always pass to the westward and in-shore of the Falklands. [See From the line to the Pacific, p. 141.] Take the Straits of Le Maire, if it is possible to

get through them in the daytime, because the currents in them are singularly strong and variable; then pass along as close to the cape as the winds and rocks will permit. But if, after passing the straits and before getting around the cape, the winds are found strong from the westward, it will be preferable to stand to the southward instead of beating near the land, in order to find lighter winds, which will probably be found some distance off shore. However, even in such a case, care should be taken to profit by every variation of the wind, and, until the cape is doubled, to choose the tack which gives the greater westing. Vessels bound to Valparaiso or vicinity should not, when to the southward of 50° S., make as much westing as those bound to California. These last may conveniently cross the parallel of 50° S., when they are close to the eastward of 100° or 110° W.; and they most frequently cross it between 80° and 90° W.

In the whole of the preceding there was but one thing positively determined, and that was the most favorable season of the year in which to make the quickest voyages. We have already said that the preceding table of averages, taken from Maury, does not leave the slightest doubt on the subject. But we must add that nothing is proved in a positive manner, as to whether this is also the best time for the passages, when we have in view the gales and damages to shipping which must be encountered.

As for the route to be followed, we think the extraordinary diversity of opinion which exists on this subject makes it necessary to state the following as a principle: "*There is no absolute rule which will answer for this special navigation.*" Each navigator should follow his own calculations, according to the circumstances of wind and weather, and the qualities of the vessel he commands, and finally, it is necessary to say, according to his own sailor-like qualities. We shall explain farther on what we mean by this expression.

In our opinion the following will be about the notion derived by any reader, from the various authorities quoted and by a study of the pilot-charts, of the prevailing winds in the locality of Cape Horn.

After having reached the parallel of 50° S., by following the advice given in From the line to the Pacific Ocean, p. 141, a line may be traced on the chart joining the position of the vessel and Cape San Diego (Straits of Le Maire); and then every endeavor should be made to keep to the westward of that line. In order to do this, since the winds prevail from NW. and SW., advantage should be taken of the NW. winds to make a course of SW. by S., or even SW., true, in such a way as to gain a position well to windward and so as to be able to stand to the SSE. without inconvenience when the wind hauls to SW. The worst season in which to make this fraction of the voyage is from the 1st of January and the 1st of April, as during this time the SW. winds are most frequent.

Upon reaching the vicinity of the Straits of Le Maire, in sailing vessels, no hesitation should be felt in taking it, provided the wind is strong and well-established from the N., NE., or NW., the barometer steady, and the appearances indicate settled weather, and finally, if one feels himself thoroughly acquainted with the working of his vessel. In all

other cases where any hesitation is felt, they must resign themselves to taking the outside route, doubling Staten Island, by passing a good long distance to the eastward of Cape Saint John; in this way all fears may be laid aside, although the passage will be a little longer.

With fine auxiliary steamers, a corvette, for example, there is no excuse whatever for not taking the Straits of Le Maire unless strong SE. or SW. winds are found at the entrance, or the weather has a very bad appearance.

At all times every possible effort should be made to pass through the straits in the day-time, on account of the violent and irregular currents against which one has to contend.

When leaving the straits the route to be taken to double Cape Horn will be about SW. Now, this will be easily made, if one has the good fortune to have NE. to NW. winds, which, by the way, are not at all rare; and with them a good passage may be made, doubling the cape at a short distance from it. But if the winds are found to be W. or SW., what is then to be done? Fitz-Roy thinks it best to beat to windward close in-shore, taking advantage of every lull of wind and sea, and running for shelter, in case of very bad weather, into any of the many different bays of Tierra del Fuego, which he has pointed out. In our opinion, this is the only thing to be done in such a case, and, in fact, the only way in which quick passages can be made under such circumstances. But, on the other hand, we think that no one should give instructions or advice in a general way which may at any given moment place a vessel in a very critical position. Fitz-Roy, who, by the way, was perfectly acquainted with those localities, as he made a hydrographic survey of them, and with him officers familiar with the passage around Cape Horn, and particularly whalers and certain captains of merchant-ships, have, all of them, run close in-shore of the coast of Tierra del Fuego without the least hesitation, and have in that way made some very quick passages. In fact they have counseled and extolled that route. But since these instructions are written for captains who know little or nothing of the voyage they are to undertake, we think we should be taking a great responsibility on our shoulders were we to sustain the theory of Fitz-Roy, and in that way to expose a sailing vessel to being carried in sight of Tierra del Fuego by SW. winds, which might freshen up, and force her to seek shelter under a coast with which she is totally unacquainted. In other places nothing would be more natural; but in the localities of which we speak the case is very different. No buoys, no lights, no pilots, few detailed charts, and, above all, an exceedingly inhospitable coast, toward which the winds drive and imperfectly known currents are setting; without counting that there is nothing to be found there in the way of provisions, or for repair in case of sustaining damages.

This, in our opinion, would be the thoughts of an officer who had never doubled the cape, and who was given the command of a sailing

vessel about to make that voyage. Some captains, either upon the spur of the moment, or after a previous voyage in which they have been irresolute, may take upon themselves to follow the route as given by Fitz-Roy. It is a question of what we have before referred to as sailor-like qualities.

We think, then, that sailing vessels, finding the winds at SW. when leaving the straits, should generally take the starboard tack. If the vessel is an auxiliary steamer, she may at first make a good route under steam so long as the wind is not strong enough to stop her; and it may sometimes happen that the wind will haul to the S. and SE., then to NE., which will allow a very quick passage to be made. To sum up, when to the eastward of the meridian of Cape Horn, it will be prudent to avoid getting very close to the coast. With this single reservation, we can recommend the constant choice of that tack which gives the most westing.

After having passed the meridian of the cape, there is no longer anything serious to be feared in the neighborhood of the coast. The route to be followed will be about WNW., and vessels may run NW. by W. or even NW., so long as they remain from 50 to 60 miles off shore. The winds will predominate from NW. to SW., and may always be advantageously utilized, except when it blows a gale from the NW., because in that case vessels will have to "lie to" on the port tack. In all other cases, the NW. winds will permit a course of SW. or WSW. to be run, which will be a very fair one; on the other hand, if the winds from SW. blow very strong, a still better course may be made on the port tack. The real difficulty in doubling Cape Horn consists in running down the longitude between the meridian of Staten Island and that of 68° or 68° 30′ W.

In regard to the best point of crossing the parallel of 50° S., we think it sufficient if it is crossed at 80° W., when bound to Valparaiso or any other port in Chili or Peru; but it is certain that vessels bound to California or Mexico have every advantage in crossing that parallel much farther to the westward (about 95° or 100° W.), that is, provided the winds and weather encountered will permit its being done.

Note on the Straits of Magellan.—It is not our intention at present to give a full and complete exposition of the many different instructions applicable to the navigation of these straits. All the desirable notices on this difficult pilotage may be found in the instructions of King and Fitz-Roy, in the hydrographic annals of 1863, 1864, 1865, 1866, &c.; and we shall limit ourselves in this section to the general ideas which were suggested to us by the study of those instructions and the reports of various captains who have navigated on that route for a number of years.

We shall first speak of the passage from the *Atlantic to the Pacific*, or from east to west.

Sailing vessels cannot go through the straits, at any time of the year, without exposing themselves to serious risks, and a long and laborious passage. However, small vessels, which are not considered able to buffet the heavy seas and bad weather off the Horn, may find themselves obliged to take to the straits; but even they should not take this determination except from April to September, which, according to King and Fitz-Roy, is the most favorable season, and at the same time it should always be looked upon only as a last resort.

In regard to steamers, such as packets and mail-boats, every one knows that they have no other route to follow. That is, it would be very foolish for them to go round the Horn, and thereby lengthen their voyage some hundreds of miles. This is the case with the English mail-steamers which touch at Bordeaux regularly twice a month, and which go from that port to Valparaiso in 33 days, touching both at Rio and at Montevideo.

This question of going by way of the straits is rather complex when we come to consider the case of auxiliary steamers; and the various authors, as well as the commanders of those vessels themselves, are far from agreeing on the subject. It is true, as a general thing, that vessels of this description when bound to the Pacific, do go by way of the straits; but, on the other hand, many of them have, after going round the cape, made much quicker voyages, and that without any serious accidents. We may cite, for example, the case of a large gun-deck screw corvette, which left Montevideo the 2d of July, and, on the 30th of the same month, anchored in Valparaiso; while another corvette of the second class (single-decked) left Montevideo the 21st of June of the same year, and had not arrived at Valparaiso the 11th of August, having been 50 days at sea. The first went around the Horn, and the second through the Straits of Magellan.

King, Fitz-Roy, and Kerhallet agree in saying that the most advantageous season for passing the straits is between April and October. Nevertheless, this is the season of short days, which occasions another difficulty in having to make the passage by stages, and it is always a question whether the next anchorage can be reached before night-fall. On the other hand, in summer, that is, from October to April, the days are very long, and if the weather is fine the anchorages will be fewer, and a quicker passage may be made. But it must be remembered that this is the season of bad weather and westerly winds, which is undoubtedly the reason why the southern winter is chosen as the best season for making the passage.

In our preceding example, the corvette which doubled the Horn did so in the season which Maury says is the very worst in the year for making the outside passage; while the smaller vessel went through the straits in the season which King and Fitz-Roy both say is the very best; and these two cases, which completely contradict the general opinions on the subject, are by no means the only ones we have noted.

We shall add, finally, that as a general thing, when wishing to make a good passage during the southern winter, the lateral channels should not be taken.

An anchorage may be made, if it is necessary, in Port Mercy, 4 miles from Cape Pillar, where a well-established fair wind may be waited for, with which a good run may be made off the land. This precaution is all the more valuable in proportion as the sea is heavier and more troubled at the western end of the straits, which is always the case during and after heavy gales blowing on shore.

To sum up, we think that, from December to April, and especially in December, January, and February, which are the most favorable, first-class auxiliary steam vessels, like sloops of war, may make a very fine passage by taking the Straits of Le Maire and doubling Cape Horn proper. The months of April, June, and August are also advantageous for this route (see the table in the preceding section), and they are all the more so, as they correspond to the season of short days which is given by both King and Fitz-Roy as very favorable; and, besides, this season is not the least troublesome for passing through the straits. In a word, we think that the outside route, which is almost entirely abandoned by auxiliary steamers, might in certain cases be followed with advantage.

Full-powered steamers and small auxiliary steam vessels should, in all cases, take the Straits of Magellan. The best season for this last style of vessels is from April to September, because in that time they will experience the least amount of bad weather; but for large full-powered steamers the best season is from September to May, because, in this season, in spite of the head winds and bad weather, a more rapid passage may be made, on account of the long days, which allow them to keep under way almost all the time. This is particularly the case in November, December, and January.

Let us now examine the passage from the *Pacific to the Atlantic*, that is, from west to east.

All steamers and auxiliary steam vessels, whatever the force of their engines, should at all times pass through the straits, as it will be very much to their advantage.

King and Fitz-Roy say that the season from April to September is the least favorable, not only because the days are very short, but because easterly winds are much more frequent, especially in June and July, during which, in fact, easterly gales are often encountered. This unfavorable chance will be appreciated by small vessels and auxiliary steamers of little power. It must be well understood that sailing vessels are not considered in this question at all.

According to the same authors, during the season from October to May the route by way of the straits is excellent *for all classes of vessels*, the days being very long and the wind nearly constant from the westward. We cannot say positively whether Captains King and Fitz-Roy included

sailing ships under the title of "*all classes of vessels;*" we, however, think it highly probable. On the other hand, it is well known by every one that sailing vessels do not make use of the Straits of Magellan; and we must add that, in our opinion, this route is not advisable in the present state of meteorological knowledge of the locality. However, small sailing vessels, which are doubtful about weathering the dangers off the Horn, will find a relative advantage in taking the inside passage; but these are exceptional circumstances about which we cannot speculate. As a general rule, sailing vessels should, in all cases, pass around the Horn in all seasons.

We shall mention, *en passant*, the recommendations that King and Fitz-Roy give to vessels coming from the northward in order to get into the Straits of Magellan. It is necessary for them to keep well off shore until they get the western entrance directly to leeward, so as to avoid being thrown on the wild and inhospitable coast lying to the northward of Cape Victory, and which is constantly beaten for several miles off shore by heavy and broken seas, very much resembling breakers.

The real advantage presented by the passage of the straits from the Pacific to the Atlantic consists in the better position in which vessels will be after doubling Cape Virgins, instead of being to the eastward of Staten Island. Those in this last position have not only a very heavy sea abeam, but are much farther to leeward *in case they are bound to Rio or Montevideo.* In the case of vessels bound to Europe or the United States, when going up the eastern coast of Patagonia, a much less heavy sea will be experienced than if farther off shore; but their passage to the line will not be any shorter than that of those which have doubled the cape.

We shall now examine the principal chances of weather to be encountered when running from Cape Virgins to the equator.

Route from the Straits of Magellan to the Line.—According to what has been said in the preceding section, full-powered and auxiliary steamers are the only ones which should pass through the Straits of Magellan. We shall not, therefore, occupy ourselves with the route from Cape Virgins to the equator, to be taken by sailing vessels, and this single consideration would render difficult all comparison between the route which we shall now give and that as given in Route from the Pacific to the line p. 152 between the Horn and the equator for sailing vessels alone.

However, we may say that good auxiliary steam vessels of sufficient sail power and possessing ordinary sailing qualities—screw-sloops, for example, and, *a fortiori*, the largest vessels—will be greatly benefited by going around outside of Cape Horn, and then following the Route given in Route from the Pacific to the line p. 152, rather than the one about to be given, on which head winds are often encountered, and a large expenditure of coal is frequently obliged to be made. The call at Montevideo is the only one that can be thought of after starting from Cape Virgins. It

will always be easy to get there; but, on the other hand, after calling at Montevideo, the passage from there to the line is exceedingly rough and quite long, on account of the persistent northerly winds above the parallel of 35° S., which nearly always force vessels to make quite a *détour* in their course. It also happens quite often that they are obliged to make a run on the port tack, and in that way to approach very near the route from the Horn to the line, as given from Mnotevideo to Rio, &c., p. 221.

The course from Cape Virgins to Montevideo will be about N. 30° E., and will generally be quite easily followed, even under sail, as the winds predominate from NW. to SW. No fear need be entertained about the nearness of the coast, so long as it is not approached nearer than 60 or 80 miles. Gales scarcely ever blow from the eastward; so that, in bad weather, the wind and the sea will always help to drive a vessel on her course; and, besides this, the sea will be much lighter close in-shore.

The route from Montevideo will be given on p. 221; accordingly, we shall not give it in this place.

We shall only occupy ourselves with the *direct* route, from Cape Virgins to the line, to be followed by vessels which do not intend to stop at Montevideo. The call at Saint Helena is not even to be thought of in this connection. If a call at that place were contemplated, we might ask why did not the vessel go round the Horn, which would have been by far the best way? In the following table will be found the principal points of crossings for the *direct* route, which appear to be the best for an auxiliary steamer to make when running from the Straits of Magellan to the line. After which may be found a few remarks upon the route for each season. We shall also give the reader, in From Rio to Bahia and the line, p. 203, and From Montevideo to Rio, p. 221, some detailed instructions upon the latter part of the route about which we are now speaking:

Seasons of the year.	Longitude of intersecting the parallels of—						
	45° S.	40° S.	30° S.	25° S.	20° S.	0°	
	W. long.	W. long.	W. long.	W. long.	W. long.	W. longitude.	
						For the channel.	For New York.
	° ′	° ′	° ′	° ′	° ′	° ′	° ′
January, February, and March	54 15	45 40	30 00	27 00	26 10	24 20	30 10
April, May, and June	55 40	47 48	33 30	30 00	27 30	23 40	31 10
July, August, and September	53 30	44 12	27 30	23 40	23 00	21 10	26 10
October, November, and December	49 40	38 05	22 30	22 30	22 30	23 10	30 00

In *January*, *February*, and *March*: During this season the route, as just given in the preceding table, is quite easily followed up to the parallel of 30° S. Between this and that of 20° S., which should be crossed

at 26° 10′ W., where the SE. trades commence to be felt, the winds will vary from E. to NE., N., and NW. The starboard tack must be taken with the NE. winds, and the port tack with those from N.; with all others a course, leading as near as possible through the indicated points of crossing, should be steered. If it is preferred to get up steam, so soon as head winds are encountered, on 30° or 28° S., the course should be NNE., in order to reach the SE. trades as soon as possible. The southern limits of the trades were given in Southeast Trade Winds, p. 103.

To sum up, this direct route may be accomplished, in this season, by auxiliary steamers in a little shorter time than the one from the Horn to the line can be made by sailing vessels. But the advantages of the first are very few, and, in fact, they may amount to nothing at all. Of course this depends upon the amount of N. or NE. winds experienced between the parallels of 30° and 20° S.

In *April*, *May*, and *June*, by following the route by the points of crossing as given in the table, there is no risk of being seriously retarded by head winds, except between the parallels of 30° and 25° S. This may, however, be avoided by running some distance away from the route traced on the chart, as indicated by the points of crossing shown in the table; that is to say, 35° S. should be crossed between 40° and 41° 10′ W.; 30° S. between 33° and 34° 30′ W.; and 25° S. between 29° 30′ and 31° W.

A call at Montevideo will not cause so serious a delay as during the preceding season. There will only be from 600 to 650 miles' increase in the distance, and four or five days' increase in the time of the passage.

This route from the Virgins to the line will be much more advantageous to auxiliary steamers than the one from the Horn to the line is for sailing vessels; and this advantage is much more certain than in the preceding season.

In *July*, *August*, and *September;* We have already said that this is the worst season in which to pass through the Straits of Magellan from W. to E. We will add that the call at Montevideo is also rather disadvantageous on account of the delay in communicating with the shore, which is often interrupted for days at a time by the violence of the pamperos.

That part of the route, as given in the table, extending From 35° S. to the northward. is about the same as that given in From the Pacific to the line, p. 152. Now, that part of the route between Cape Virgins and 35° S. will be very easily made by simply following the points of crossing as given, since the winds experienced will almost always be favorable. Beyond that parallel the course and weather are set forth for this season in From the Pacific to the line, p. 152.

In *October*, *November*, and *December*, the winds will be extremely favorable to the meridian of 32° W., which should be crossed at 35° or 35° 10′ S. From this time the chances of northerly winds increase; but 35° S. may always be crossed at 27° 30′ W. Beyond this the chances of north-

erly winds increase still more, and when they are met with the port tack should be taken so as to come up as near as possible to the course when the winds begin hauling to the westward. In this way 30 °S. may be crossed at 22° 30′ W. without the least trouble. Between 30° and 25° S. vessels will be very much retarded by N. and NE. winds. With the first the port tack must be taken, and with the second the starboard tack. The most important thing to be done is to cross 25° S. between 20° and 25° W., and to always keep within these limits (the nearer 22° 30′ the better) until reaching the parallel of 20° S.

After crossing 20° S., in the vicinity of 22° 30′ W., the limit of the SE. trades will have been reached, and with these a course for the line, as shown in Return route from the Indian Ocean to the line, p. 135, may be run with a fair wind.

The route just given is quite easy to follow, even under sail. It is much shorter than the one given for the same season in From the Pacific to the line, p. 152. This last, however, is for *sailing ships* running direct to the line from off Cape Horn.

The call at Montevideo at this season is very bad, even for auxiliary steamers, when coming from the Straits of Magellan; however, it is the only one we can recommend. We say it is bad, because vessels, when leaving the river, are obliged to run a long distance to the eastward, to 28° W., before they will be able to stand to the northward. Unless this is done they might get into the regions of persistent northerly winds lying just above the parallel of 35° S. The stoppage at Montevideo also obliges a large *détour* to be made, and for these reasons those vessels which are in a great hurry to reach Europe should avoid it and not stop anywhere between Cape Virgins and the line.

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CHAPTER VII.

Doubling the Cape of Good Hope from east to west.—In remarks on doubling Cape Horn from east to west, p. 164. we stated that upon all difficult or important questions the opinions of the various authors would be found to differ. This applies to the passage around the Cape of Good Hope, as we showed that it did to that around Cape Horn.

D'Après de Mannevillette advises vessels not to get more than 12 or 15 leagues off shore when returning from the Indies. Horsburgh thinks, on the contrary, that they should follow the outside line of the Agulhas Shoals. Kerhallet thinks it preferable to pass close to the land, particularly in the winter. Bridet proposes that the passage from E. to W. be made, in this season, between 45° and 50° S. latitude. Commander Villemain thinks this last advice based upon an insufficient number of observations to entitle it to much respect. Rear-Admiral Bourgois of the French navy, recommends a route, for sailing vessels at least, which is nearly the same as that set forth by Horsburgh.

We shall endeavor to present a succinct *résumé* of these different instructions, and shall point out those which appear to us to be the best.

First, we shall note what is said by D'Après de Mannevillette:

The land should be approached about the vicinity of Algoa Bay, and vessels should then work to windward, taking advantage of every slant to the NW., as also of the favorable currents. They should not get within 6, nor beyond 12 or 15 leagues of the shore, as in that space they will keep in the strongest part of the current. There need be but little fear of being thrown on to the shore, as the winds very rarely blow in that direction, and in heavy weather an off-shore tack may be taken, or, when the wind permits, the course may be parallel to the coast.

As the depth of water on the shoals is quite variable, and the edges steep-to, the lead will often be a means of estimating the distance. When uncertain about the longitude, and the weather prevents a recognition of the Cape of Good Hope or Cape Hang-lip, soundings should continually be taken, so as to know when far enough to the westward, and in no case should vessels bear up to double the cape until after they have lost the bottom to the westward of the shoals. In case bottom should be found, after having borne away to the NW., the course should immediately be changed to the westward. The southern edge of the bank seems to be made up of a number of small shoals rather than the continuation of the same long one. So that it often happens that bottom may be lost, on 36° S., while vessels are still to the eastward of the cape; so that perfect confidence cannot be put in the soundings to tell precisely when to bear away to NW., except when the vessel is to the northward of 36° S.

When coming from seaward, fogs are often found to hang like a curtain over the land, concealing the lower and leaving in view only the tops of the higher mountains.

We shall now give the principal remarks in the instructions of Horsburgh on the same subjects:

The currents of the Agulhas Bank ordinarily attain their maximum velocity during the southern winter, and on the western line of soundings; they run around the bank, following its curved form. Near the coast the current is quite feeble. It is necessary, then, in case of head winds, for vessels to take the outside of the bank when wishing to get to the westward.* But it is not necessary to get so very far to the southward, only to the extremity of the bank; because beyond the line of soundings there may be encountered, in the winter time, heavy westerly gales, which, after crippling a ship, may force her to seek shelter in Saint Augustine Bay, or at Port Louis, in order to make repairs; and this has often been the experience of navigators.†

It sometimes happens that heavy W. or SW. gales arrest the current completely; but, when they moderate, it resumes its course with almost redoubled force. At other times the current still flows to the westward in spite of the heaviest gales from that direction, thus causing a most horrible sea. Coming on to the bank, toward the land, the current is generally feeble; but the sea is always much lighter, and the winds more moderate.‡

In the neighborhood of the cape the SE. winds predominate, during the fine-weather season, from September to April, and those from NW. and W., with bad weather, during the winter, from April to September. However, from the 15th of January to the 1st of April, the SE. winds are the most constant. During April the SE. winds are broken by sudden westerly squalls; then, in May, the winds along the bank are oftener from NW. and SW., and very violent, than from SE. and E. During the month of June the winds from W. and NW. reach their full force; in June, July, and August they are so violent, and raise such a heavy sea, that, without the current, it would be impossible to double the Cape of Good Hope. However, in August the westerly winds are not so presistent as in June and July. In September, October, and November the westerly are again very frequent; and, even in December, vessels are obliged to beat during the whole month against these winds, which are then interrupted by very heavy and violent squalls; nevertheless, as a general thing, in this season the westerly gales are of short duration, although very violent. Heavy WNW. and WSW. gales may generally be expected from April to September, lasting for two or three days, and followed by variable and easterly winds.

At times the winds blow with violence from NW. and W., while the sky remains clear; but, as a general thing, the gales most to be feared are preceded by very black clouds, which rise in the NW. or W.; lightning will be seen playing through these clouds, and thunder may be heard in the distance; soon after, heavy gusts of wind will be felt, and sometimes small whirlwinds, accompanied by sleet and hail. The Dutch East India Company have issued orders to their captains, requiring them to take in the mainsail as soon as a SE. or ESE. wind hauls to the NE., and, upon the appearance of lightning in the NW., to immediately go about and reduce sail.§ In the first case, they should look out for very fresh winds from the NW.; and if lightning is observed, they should guard against being caught aback in some of the squalls or whirlwinds. The barometer is very useful in these cases; it falls considerably be-

*Rear-Admiral Bourgois says that these directions are very hard to follow, although they seem to be excellent in principle.

† It will be useful to remark that this opinion, although based on facts, is diametrically opposed to that of M. Bridet, which will be given further on.

‡ This observation is important. In case of heavy weather it will be advantageous, then, to run over the bank, and near to the shore, rather than to keep on the edge of soundings, or to take the off-shore tack. M. Bridet thinks the contrary.

§ They should go about; that is, get on the port tack to receive the approaching bad weather. (See General Westerly Winds, p. 110.)

fore bad weather, but it hardly ever varies very much before stormy weather of short duration. It generally rises with southerly and falls with northerly winds.*

It has very rarely, if ever, happened that any of the company's ships have met with ice when doubling the cape between 36° and 41° S.; but from the following instances we are led to think that many of the vessels which have been lost without leaving a trace of their fate have perished during the night-time by striking on icebergs during heavy gales. Here are some cases of ice being encountered: The French ship *Harmonie* met with large quantities of ice the 7th of April, 1828, when in 35° 50′ S. and 18° 25′ E.; the brig *Eliza*, on the 28th of April of the same year, encountered five icebergs about 37° 31′ S. and 18° 37′ E.; the bark *Le Constant*, on the 13th September, 1844, found herself in the middle of a large number of icebergs at about 38° 10′ S. and 24° 20′ E.; the ship *Rajasthan*, in the same month, when in 37° 30′ S. and 24° 20′ E., encountered a great number of icebergs; the ship *Urgent* found herself surrounded with ice on the 12th September, 1844, when in 39° 04′ S. and 26° 10′ E. The months of September and October are those in which the chances of encountering ice are most numerous; but since it has been seen in April and May, the conclusion is that a sharp lookout must always be kept for it.†

We shall now quote from the instructions of Kerhallet:‡

After having sighted the land in the vicinity of Algoa Bay, the course may be along the coast, or, *if it is preferred*, over the Agulhas Bank, in which case the edges should not again be crossed. In February, March, and the beginning of April, the winds predominating from SE., it will be better to follow the southern edge of the bank as far as 23° or 24° E.; the effect of the current, which in this part sets WSW., SW., and SSW., may be overcome by steering slightly toward the land, and in this way keeping on the bank the whole time. During the winter months (June, July, and August), in which W. and NW. gales are by far the most frequent, the course should be near the land, because the sea is not nearly so heavy there as it is farther seaward.

Generally speaking, there is not the least danger in approaching the African coast, because it is very seldom that the winds blow heavily directly on shore; so that, in general, vessels may take an off-shore or favorable tack.§ Sometimes there is bad weather to the eastward of Good Hope, while to the westward, after doubling it, there is fine weather, with strong southerly breezes.‖ Upon reaching the meridian of Cape Agulhas, with strong SW. or SSW. winds, the course should tend well off shore, in order to be able to pass to windward of Goop Hope; at night this precaution is absolutely necessary.

From these quotations it will be seen that, according to D'Aprés Mannevillette, vessels should keep within the limits of 6 and 15 leagues off shore to avoid bad weather. For the same reason, Horsburgh says to take the line of soundings of the bank, and Kerhallet advises an approach to the coast. We shall proceed to give the whole of Bridet's advice, which would carry large sailing vessels a great distance from the land to 45° S. during the winter season.¶

* See what is said on this subject in Remarks on Barometer, p. 123.

† Consult the *limits for icebergs*, p. 122, for this season.

‡ See *Considérations générales* of Kerhallet, page 121.

§ It will be seen that Kerhallet says, as does D'Après Mannevillette, that there is no danger in nearing the coast; but at the same time qualifies his assertion by saying, *in general*, thus shielding the author and leaving the navigator in doubt. We must say that, unhappily, we are almost always obliged to write instructions in that way.

‖ Rear-Admiral Bourgois gives an explanation of these facts in the *Annales hydrographique*, 1863, page 145.

¶ Among the works of M. Bridet we would mention the remarkable studies of that officer on the subject of cyclones in the East Indies.

The storms off the Cape of Good Hope are regular cyclones, traveling from WNW. to ESE., between the parallels of 35° and 40° S. latitude; the left hand or northern half being the dangerous, and the right hand or southern half being the moderate semicircle. Accordingly, if it is intended to make headway in the dangerous semicircle, and thus profit by the Agulhas current, it will be necessary to take the port tack when the weather becomes threatening. In this case it will be best to get 40 or 50 miles off shore, so as to be able, in case of necessity, to keep on that tack for a long time.

But it is much wiser to avoid the dangerous semicircle, and to steer on the course through the lower or moderate part of the storm, by doubling the cape, in winter, on the parallel of 45° S. Leaving Réunion at this season, vessels should cross, successively, 30° S. at 42° 40′ E.; 40° S. at 32° 40′ E., so as to make a quick run across the zone from 30° to 40° S., where cyclones prevail; then steering to cross 45° S. at 17° 40′ E., from which position the cape may easily be doubled by the aid of the SW. winds. Following this route, vessels should always have favorable winds blowing fresh from the eastward,* but without such dangerous squalls as experienced about the Cape of Good Hope. They will, of course, lose the aid of the favorable westerly current, but they gain the advantage of escaping the action of violent storms and almost constant head winds.

The route as proposed by M. Bridet was experimented on during the winter of 1862 by the sailing frigates *La Forte* and *La Vengeance*, and also by the merchant vessel *Santiago*. *La Forte*, commanded by M. Bourgois, who was then a captain, was assailed when on the parallel of 30° S. by a SW. gale so very heavy as to force him to follow the old route, as his starboard tacks carried him well to the eastward and but little to the southward. The *Vengeance* and the *Santiago* were able to conform to the route as given by M. Bridet. Finally, a third sailing frigate, *L'Andromaque*, followed the old route. The voyages of these sailing ships, and those of the auxiliary steam transports, the *Rhone*, the *Rhine*, and *L'Entreprenante*, served as a basis for M. Bourgois from which to discuss this passage around the Cape of Good Hope, and in the *Annales hydrographiques* of 1863, pages 123 to 145, will be found the best elements and the most complete instructions in regard to the route to be taken by both sailing vessels and steamers in order to make a good voyage around the Cape of Good Hope. We shall return to this remarkable work in a few moments.

M. Villemain, a captain in the French navy, also made a report upon the same subject, in the year 1863:

The frigate *La Vengeance*, in following the route of M. Bridet, found the winds constantly ahead, but less violent; as also a much lighter sea, and consequently the damages were very slight. Further, she made a very quick passage in spite of the current, which she found to be contrary. The same was experienced by the *Santiago* in her two voyages in 1861 and 1862. However, these results, by reason of their small number, cannot be taken as so conclusive that we may at present advise a complete abandonment of the old route for doubling the cape from E. to W., in the winter months, May to September.† Nevertheless, the long passage, the monstrous seas,

* It will be seen, further on, that these conjectures are not realized in practice.

† It may be seen that although Villemain's opinion seems rather reserved, it is at the same time favorable to M. Bridet's proposition. Further on will be the opinion of M. Bourgois, which is more decided.

the heavy damages, and the dangers of every kind which attend the route by way of the Agulhas Banks, at this season, is a strong reason why new trials should be made of the route as proposed by M. Bridet.*

We shall now give a *résumé* of the refutation which the then Captain Bourgois published in 1863, as was mentioned a short time since, and from which it appears that the gales off the Cape of Good Hope should not be looked upon as cyclones. The following is almost a reproduction of his remarks:

There are two principal signs which establish a distinction between cyclones and ordinary gales of wind: 1st, the movement of the barometric level; 2d, the order of succession of the winds.

It is well known that the variations in the barometric column follow very different laws, according as the wind blowing is a cyclone proper, or one of those turning winds or whirlwinds of which we have often spoken. In the first case, whatever may be the direction of the wind, the barometer always falls as the distance from the center becomes less and at the same time the force of the wind increases; on the other hand, the barometer rises and the wind diminishes in force as the distance from the center becomes greater. In the second case, as a general rule, the barometer rises with a polar and falls with an equatorial wind, and its oscillations are not affected so much by the force as by the direction of the breeze. Now, applying this knowledge to the gales off the cape, it is easy to see that not one of those observed by the vessels of the Chinese expedition on their return to France had the characteristics of a cyclone proper.

In regard to the order of succession of the winds, we should observe that the shifts of wind from NE. to NW., W., and SW., which are rather frequently observed in the vicinity of the cape; the repeated oscillations of the wind from NW. to SW., which are seen along the coast between Cape Agulhas and the bay of Algoa; and finally, the complete rotation of the winds, which happens oftener and at the same time more marked to seaward than near the land, are for the most part rather characteristics of the common temperate-zone gales than explanations of the theory of cyclones. The manner of these rotations of the winds about the locality of the cape is the same as that of the whirlwinds of the temperate regions of the southern hemisphere. (See General Westerly Winds, p. 110.) And, finally, we may notice that the gales about the cape incontestably have their origin in the direction from which the wind blows, and this is not the case generally with cyclones.

To these considerations we may add the important fact that the frigate *La Vengeance* and the ship *Santiago*, when following the new route, never encountered the winds of the *moderate semicircle;* that is to say, they never encountered the constantly favorable easterly winds, as announced by M. Bridet; on the contrary, they had the winds from WNW. to SW. Therefore, the theory of M. Bridet was not confirmed in 1862 by the before-mentioned vessels.†

We will end our set of quotations by reproducing the instructions of Admiral Bourgois, which will be found to be more precise than any of the preceding. We do not hesitate to quote them *in extenso*, because they are the best guide that could be followed, and for the reason that good advice cannot be too often repeated; finally, and especially, because the greater part of our readers will not have the means of refer-

* It is now nine years since M. Villemain put forth this view, and yet we cannot find the record of a single vessel having followed that route.

† On this subject see the report of M. Villemain, page 8.

ring to volume xxiii of the collection of *Annales hydrographiques* for 1863, pages 142 and 143. This is what he says:

Under many circumstances a zone of moderate winds extends a short distance from the coast of Africa, while heavy weather is prevailing to seaward; but it appears that the winds prevailing a long distance to the southward do not differ from those which are encountered on the Agulhas Bank, except that the latter are more regular and consequently a little fresher, while the sky is overcast and the weather very cold. Under these circumstances it will be seen that there is no reason for getting to the southward of 45° S., as is advised by M. Bridet; but, on the other hand, and in opposition to the opinion of Horsburgh, there need be no apprehension of encountering heavier gales when to the southward than are met with on the bank itself.

Full-powered steamers and *small* sailing vessels have an evident advantage in navigating close along the shore until reaching Cape Agulhas, because they will there experience finer weather, a favorable current, and a lighter sea.* In regard to *large sailing vessels* they should steer (when the wind is favorable) to sight the coast of Africa in the vicinity of Algoa Bay, and should then run, slightly increasing their distance from the land, passing around the southern edge of the Agulhas for the position of 37° S. and 17° 40′ E. In this way they will profit by the strongest current, and will gain a position from which the Cape of Good Hope may easily be doubled in case they are surprised by a westerly gale. When the wind is unfavorable, they should take that tack which is nearest the course, preferring to remain in the current, provided the weather has a good appearance, and keeping well outside the bank if the appearances indicate bad weather. These appearances or indications are rarely deceptive, and when the barometer falls, with the winds from E. to N., the weather becomes cloudy and lightning is seen to the westward, we may be sure of an approaching gale, and every precaution should be taken against sudden shifts from NE. to NW., then to W. and SW.†

The rule given for such circumstances, in order to avoid being caught aback, as also to receive the sea in the most favorable direction, when the wind hauls, is *to get on the port tack*;‡ but the vessel which hastens to follow this rule runs the risk of having to wait a long time for the change of the wind, and in this way may lose a long distance on the route by steering to the eastward, or by approaching so near the land that remaining on the port tack will not be possible at the very height of the gale, that is to say, at the very time when the board on the starboard tack is most inconvenient. We advise, therefore, that vessels, when on the Agulhas Bank, in *doubtful* weather, with the winds from NE. or N., take a reef and shorten sail in good time, *particularly if lightning* is seen to the westward and the barometer falls; but we would recommend them, also, instead of going about immediately, to *stand on to the southward and westward*, so as to gain in that direction while the winds remain to the northward of NW., and so long as the state of the sky to the W. and SW., joined to the falling of the barometer, does not threaten an immediate change of the wind. In fact, by steering this way and *keeping the head-yards sharp up*, there will be nothing to fear from a shift to SW., and they will continue to make on the course to the SW., which is an advantageous direction. At all events, they will be in a better position,

* Thus it is seen that the auxiliary steam vessels, when returning from the Indian Ocean, follow a route analogous to that given by D'Aprés Mannevillette for sailing vessels.

† We have already given the signs of bad weather, as set forth by Horsburgh.

‡ Horsburgh gives the same rule, and points out the instructions which captains of the Dutch company were ordered to follow upon the appearance of bad weather. We gave this interesting passage some few pages back. But it is of great importance to notice the details of Admiral Bourgois for choosing the precise moment of changing the tack for receiving heavy NW. weather.

after being forced to go about, for keeping on the port tack during the height of the gale.

The essential thing, then, is the choice of the proper moment of going about. The experience of a seaman acquired by an attentive observation of the weather is the best guide. This will save to those who possess it many of those wearisome days which are sometimes employed in beating against the heavy seas and violent squalls of the Agulhas Bank. The barometric indications cannot be regarded as infallible. In this locality, according to Horsburgh, heavy gales may be encountered, with a high barometer; but a storm may be expected if it falls to the vicinity of 29.50 inches.

In maneuvering in this way there is the advantage of getting away from the bank and the current at the commencement of the gale, when the sea occasioned by the wind against the current is necessarily very heavy; and also of returning to the edge of the bank, at the end of the gale, in order to again profit by the current. After the westerly winds have blown for some few days, the Agulhas current ceases entirely, and although the sea may still be very heavy on the bank, this will be accounted for by the shallowness of the water. In this way, it will be seen that there is less inconvenience in getting on the edge of the bank at the end than at the beginning of the gale. It is known, however, that the current attains its greatest velocity during the southern winter, when the effect of the sun is least felt on the Indian Ocean, and where the trade-winds, on the contrary, are in their full force.

After having produced these complete instructions of Admiral Bourgois, which form the conclusion of the preceding series, and solve all doubts which may have existed on the perplexed question of the passage around the Cape of Good Hope, it remains for us to give a few brief instructions on the anchorages of Table and Simon Bays. A call may be made at either place, in case of accidents or want of provisions, but this should only be done in cases of absolute necessity.

Table Bay.—During the summer, from October to April, the predominating winds, in Table Bay and about the Cape of Good Hope, are those from SE. to ESE., which bring fine weather. Sometimes, in January, February, and March, these winds blow with exceeding violence, and vessels have been driven to sea by them, even after having let go all their anchors; in such cases, these same vessels have been unable, for the space of five or six days, to regain the anchorage. In spite of this, and of the fact that vessels are sometimes driven ashore by the force of the NW. winds from November to April, every one agrees in thinking this a practicable and comparatively secure anchorage, from October to the 10th of May.

In winter, and principally in June, July, and August, the anchorage is dangerous. The winds from W. and SW., accompanied by rains and fogs, are very violent; those from NW. being still more so. These last blow in tempests, often lasting several days, and are accompanied by thunder, rain, and sometimes hail; they also give rise to a very heavy sea. During this season, and notably in June and July, many vessels have been entirely lost, ship and cargo, in Table Bay.

In summer, this anchorage is favorable for revictualing. Good water, meat, provisions of all sorts, vegetables, fruits, &c., are found there. But it is recommended never to enter the bay at night, in any season, particularly if the weather is overcast and squally.

Simon's Bay.—This bay, lying 12 miles to the northward of the Cape of Good Hope, is situated in the NW. part of False Bay, at the foot of the highest mountain of this coast. *In winter*, from *April* to *September*, when Table Bay is insecure, shelter may be had in Simon's Bay, which is considered a good anchorge at all times of the year. The anchorage is open to winds from NE.,E., and SE. The bottom is sandy, and is good holding-ground. From *May* to *September* vessels are obliged to moor NW. and SE., with the heavier anchor to the NW., in order to ride out the heavy NW. squalls which come down from the mountains. From *September* to *May*, *it is preferable to anchor in Table Bay;* nevertheless, if obliged to touch at Simon's Bay, vessels must moor NW. and SE., putting the heavier anchor to the SE., in order to ride out the winds S. and SE. Those from NE. and E. are never violent.

The water here is excellent and easily obtained; everything in the line of provisions comes from Cape Town, 18 miles distant.

It often happens that the wind blows very fresh for one day and part of the night; then it moderates toward the morning, and is replaced by a breeze from off the land, that is, from WNW. By getting under way in good season with this breeze, vessels may sometimes gain an offing before the return of the SE. wind; but, if an offing entirely clear of the cape has not been gained before the breeze sets in strong from the SE., it will be better to return to the anchorage. Vessels bound to the eastward should leave the bay at the commencement of the NW. winds; those which, *during the winter*, are bound to the westward, should, on the contrary, wait until the NW. winds haul to W. before making sail, because the wind will then soon haul to SW., S., and SE., which will be favorable for doubling the cape.

We here give the remarks of the captain of one of the largest French sailing frigates, after having passed ten days at Simon's Bay, in February, 1868:

> The anchorage is very bad, especially in the summer. Sailing vessels will find the entrance difficult, and can never know at what time they may leave. There is nothing but a small village there. The SE. wind blows very strong; the communication with the shore is very difficult; all provisions come from Cape Town, and are a long time on the way, and of poor quality; they cannot be refused without the risk of having none at all, or of having to wait a still longer time for others to reach you, &c.

In ending our considerations on the passage around the Cape of Good Hope from east to west, we will repeat, that no one should call either at Table Bay (in summer) or at Simon's Bay (in winter) except in cases of absolute necessity from want of repairs; on the other hand, it will be much more advantageous to get away from the localities with all the speed possible, and to run on, and, if necessary, touch at Saint Helena, where vessels lie in all security. We have already said (From Cape of Good Hope to the line, p. 139) that Saint Helena is directly in the route of vessels running from the Cape of Good Hope to the line, and that by calling there no time is lost except that spent at the anchorage.

Passage around the Cape of Good Hope from west to east.—As a general rule, the cape is easily doubled from west to east by running on the parallel of about 40° S., so as to take advantage of the westerly winds and the Agulhas counter-current.* *During the southern summer*, from September to May, and particularly in December, January, and February, the route should be still more southerly, since at this season the prevailing winds in the locality of the Cape of Good Hope are those from SE. By running down to 40° or 41° S. the winds will nearly always be westerly, and there will be greater certainty of avoid, ing the contrary current of Agulhas, which, by the by, reaches farther to the southward than at any other time of the year. *During the southern winter*, from May to September, as the prevailing winds are those from the westward, and since the Agulhas current does not extend so far to the southward, it will not be necessary to steer for so high a latitude.† During the season of persistent westerly winds, *i. e.*, from May to September, vessels bound to any of the ports just to the eastward of the cape may oftentimes coast along the land inside of the current as far as Cape Saint Francis, where it will begin to be ahead.‡

We will return to the passage around the Cape of Good Hope from west to east, in discussing the voyages of circumnavigation.§ We will confine ourselves at this point to saying that a call at the cape should never be made, except in cases of absolute necessity. A sojourn of 10 or 12 days at Table or Simon's Bay will lengthen the voyage to New Caledonia by at least *one month*. The remarks on these two anchorages have already been given when speaking of the passage to the westward. The reader will also find there some important facts in regard to icebergs, which are taken from Horsburgh's instructions.‖

Route from the line to Bahia.—This route is very easy to follow, provided vessels have previously carried out our instructions as given for the navigation of the North Atlantic Ocean (France to the Equator, p. 71, and From New York to the Equator, p. 86). In those paragraphs will be found the advice of Maury, as also that of the Utrecht Observatory, upon the choice of the proper meridian at which to cross the equator, and on the courses to be pursued, according to circumstances, in order to easily double Cape Saint Roque. After doubling this cape, it will be very easy to stand down the coast, since the winds always blow from SE. to ENE. We shall quote a couple of voyages for information, which may be interesting to captains having to make this pass-

* On this subject see what has already been said in Currents of the South Atlantic, p. 116.

† Contained in "instructions for going from the Channel to Java," translated by Lieutenant Lehelloco, French navy.

‡ This advice, which is taken bodily from the "Routier des côtes, S., SE., and E., d'Afrique, No. 421 du Dépôt," applies, without doubt, to vessels bound to ports on the SE. coast of Africa and Madagascar.

§ See General Examination of the Indian Ocean.

‖ On this subject see also Icebergs, p. 122.

age; but, at the same time, it must be well understood that two isolated cases like these do not in anyway change the spirit of the general instructions, to which reference must be made.

A large French sailing frigate, the *Alceste*, left Teneriffe the 7th of June, 1869, coasted along to westward of the Cape de Verde Islands, and crossed 10° N. at 26° 10′ W., hoping to find the variable winds and SW. monsoons, and proposing to cross the line between 27° and 28° W.* But at 7° N. the SE. trades succeeded those from NE. without any interruption, and the frigate was obliged to take the port tack much sooner than she had expected. She was forced to cross the line to the westward of 29° W. Between 3° N. and 5° S., the current set her to the westward at the rate of 30 miles in 24 hours; finally, the SE. trades blew from well to the southward with great persistence. In this way she was forced, in order to double Capes Saint Roque and Saint Augustin, to make several easterly boards on the starboard tack. In working to windward she followed the advice of Maury, and anchored in Bahia the 5th of July.

The school-ship *Jean Bart* left the region of the NE. trades toward the end of November, in 1868, at longitude 29° W., and did not experience a single hour of calms. She was forced to cross the line at 34° W.† and in this way was "backed-strapped" behind Cape Saint Roque. She found no difficulty whatever in doubling the cape, by working along on soundings, and did not experience the slightest unfavorable current; while, in the other case, a westerly current of over 1 knot per hour was felt. The Jean Bart ran along the shore from Saint Roque to Pernambuco, within 6 miles of the land, and anchored in Bahia the 7th of December.

According to Horsburgh‡ there will be no difficulty whatever in getting to the southward at any season of the year, provided the land is not brought close aboard to the northward of Cape Saint Augustin. Several vessels having made the land, even in the unfavorable season from March to October, at 7° or 8° S., which is well to the northward of this cape, have found no difficulty whatever in getting to the southward, although when beating they experienced a slight northerly current.

However, from March to October, that is, during the season of SSE. to SE. winds, *it will be imprudent*, with a vessel of ordinary sailing powers, to sight the land to the northward of Saint Augustin, if it is pos-

* The Dutch instructions prescribe crossing the line at 27° W., in *June;* Maury advises 31° 08′. (See pp. 71 and 86, North Atlantic.) It should not be forgotten, however, that this frigate had orders to touch at Bahia, which is a bad stopping-place when bound to Oceanica by way of the Cape of Good Hope. (See General Examination of the Indian Ocean.)

† The Dutch instructions prescribe crossing the line at 26° 10′ W., in November and December; Maury says at 31° 10′ W. (See France to the Equator, p. 71, and From New York to the Equator, p. 86, North Atlantic.)

‡ See first part of Horsburgh.

sible to avoid it. They certainly should not make the land to the northward of Cape Ledo, nor near Cape Saint Roque, on account of the SE. winds; the current will also be found setting WNW., which may force vessels beyond Cape Saint Roque. This last has often happened. During the other season, from September to March, the winds haul to the ENE. and NE., and the current generally sets to the southward. This remark will apply to the whole length of the Brazilian coast, so that the land should be made to the southward in the first season and to the northward in the second, in order to be always to windward of the port of destination.

In regard to *Bahia*, M. Mouchez * says there is no difficulty whatever in the land-fall, which should be made, according to the season, or rather according *to the prevailing winds* either a few leagues to the northward of Cape San Antonio, or to the southward on the Morro Sān Paolo.

Route from Bahia to the line.—In January, February, and March, after leaving Bahia, and up to the parallel of 10° S., the winds will be found blowing constantly from SE. to E., and sometimes from ENE. With the winds from SE. to E., the starboard tacks may be kept aboard, but when the wind is from ENE. (an exceptional case) the proximity of the land may force a board on the port tack to be made. However, it should always be remembered that the winds become favorable in proportion as northing is gained, and that it blows from SE. to the northward of the parallel of 10° S., so that there is every advantage to be gained by running as far to starboard as possible. Generally 10° S. may easily be crossed between 32° 10′ and 33° W.; at all times avoid crossing it to the westward of 33° 10′ W., as in that direction the winds hang on at E. for a much longer time. Beyond 10° S., easterly winds may be counted on. It will suffice then to steer a good full, and *directly*, in such a way as to cross the line at the point chosen by means of Route Equator to France, p. 78, and Route New York to the Equator, p. 86, North Atlantic instructions. Vessels *bound to the United States* should cross the equator at 30° 10′ W., and those for the *West Indies* at 36° W. (they will look out for the westerly current abreast of Cape Saint Roque and Fernando de Noronha); vessels *bound to Europe* should make a direct route to reach the line—in January at 24° 30′ W., in February at 24° W., and in March at 24° 30′ W.

In *April*, *May*, and *June*, leaving Bahia, the winds will be from SE. to NE.,† so long as the meridian of 35° W. is kept to the eastward. In this part of the passage the starboard tacks should be kept aboard so long as the winds do not get to the northward of E.; but so soon as they haul to E. by N., and especially to ENE., it will be advantageous to go about in order to make the most easting possible. In maneuvering in this way, the course will rapidly tend to cross 35° W. at a lati-

* Description de la côte du Brezil; Dépôt, No. 367, pages 30 to 35.

† See the remarks about Southeast Trade Winds, p. 103, and Winds on Coast of Africa, &c., p. 111.

tude between 11° and 13° 30′ S., but never to the southward of 13° 30′ S. From here the winds will always be from SE., and with them vessels may steer directly for the point at which it is desired to cross the line. Vessels *bound to the West Indies* will cross at 35° W., and those *bound to the United States* will run to cross at 31° 10′ W.,* but they should guard against the westerly current when abreast of Cape Saint Roque and Fernando Noronha. Vessels *bound to Europe* will cross the line in April at 24° W., in May at 24° W., and in June at 23° or 23° 30′ W.†

In *July*, *August*, and *September*, leaving Bahia, the winds will be variable from SE. to E., with which vessels should lay very close on the starboard tack. In case they are found very persistent from E., the vessel may get too near the land to continue on the same tack, when a short board must be made on the other tack; but this very rarely happens. As we said, in all cases it will be necessary to hug the wind, even when it blows from SE. or SE. by S. until reaching the meridian of 32° 10′ W. From this place, only, will there be any certainty of the wind remaining at SE. up to the equator. There will then be nothing to do except to steer directly for the point of crossing.‡ Vessels *bound to the United States* should cross the line at 28° 10′ W., and 5° N. at 27° 30′ W.; those *bound to Europe* should cross the equator at 24° or 24° 30′ W., and the parallel of 5° N. at the longitude indicated Route Equator to France, p. 78, of the instructions for the North Atlantic. Between 0° and 5° N. the winds will be from S. and SE., without calms. Vessels *bound to the West Indies* should cross the line very far to the westward, at 37° 30′ W., in this season.§

In *October*, *November*, and *December*: This season is very unfavorable for the beginning of the voyage. The winds will vary from SE. by E. to ENE.,‖ to the southward of 10° S., and from Bahia to the meridian of 32° or 32° 30′ W. On the other hand, to the northward of 10° S. they will be well established from SE. so soon as the meridian of 33° 10′ W. shall have been passed. From these considerations it results that after getting in a good position, some distance from Bahia, it will be necessary to take the starboard tack, and make the most northing and easting possible. With the SE. wind, NE. will be the best course to steer; with ESE. winds, the course should be "full and by," and if the wind hauls to E. and ENE. the course should still be the same, making northing as long as possible; that is, so long as the proximity of the land does not force vessels to go about. Generally, the wind will

* See Route Line to New York, p. 94, in instructions for navigating the North Atlantic.

† See Route Equator to France, p. 78, instructions for North Atlantic.

‡ See Route Equator to France, p. 78, and Route Line to New York, p. 94, instructions for North Atlantic.

§ We will give farther on, in the route from Brazil to the West Indies.

‖ See the Indications in Southeast Trade Winds, p. 103, and Prevailing Winds, African, &c., p. 111.

haul fair in proportion as northing is made. When 10° S. shall have been crossed, generally about 32° 10′, or 32° 40′ W., the winds will be found well established from SE., with which a good full may be carried, making a course directly for the line.* Vessels *bound to Europe* should cross the equator in October and November, between 22° and 24° W., and in December between 23° and 25° W. Those *bound to the United States* should cross at 30° W., and those *bound to the West Indies* should cross very far to the westward, at 37° 10′ or 37° 40′ W.

Routes from Bahia to Rio de Janeiro, and from Bahia to Cape Horn.—The route from *Bahia* to *Rio de Janeiro* † is nearly always easy on account of the winds predominating from SE., E., and NE. Generally they haul to ENE. and NE. from September to April; while, during the rest of the time, that is, from April to September, they blow oftenest from ESE. and SE., so that it is only during the months of May, June, July, and August that sailing vessels will be delayed by contrary winds. At this season they may at times experience south or southwesterly squalls, during which, if too near the land, they may make an off-shore tack. They may pass either side of the Abrolhos Shoals, according to the position from which the islands are sighted. About the parallel of Cape Saint Thomé vessels will have the greatest number of chances in favor of head or contrary winds, and these chances are the greatest in the month of June. These unfavorable chances are much fewer in number at a distance of 80 or 100 leagues off shore; but, as the passage always necessarily ends by sighting Cape Frio, there is no advantage whatever in standing off to find these favorable winds. During the greater part of the year, from the 1st of September to the 1st of May, there is always a good wind for standing down the coast. *Full-powered steamers* should always run along in sight of the land, the whole way from Bahia to Rio, because this gives them a chance to rectify their position, besides being the shortest route. On this subject special instructions will be found in the work of Mouchez, pages 26, 27, and 28. There are no special instructions to be given in regard to the point at which land should be sighted in the first place, nor is there anything said about the entrance to Rio; all the land about the bay, islands, or coast, is high, clear, and steep-to. We will only say that calms are quite frequent to the westward of the meridian of 40° W., and between the parallels of 22° and 26° S., as is indicated by the table of calms, p. 102.

The route from *Bahia* to *Cape Horn* is in the main exactly similar to that given for vessels bound from the line to the Pacific. The only part that we have to consider is that fraction of the passage which extends from Bahia to the main route, whose points of crossing were given in Route Line to the Pacific, p 141.

* See paragraphs Route Equator to France, p. 78, and Route Line to New York, p. 94, North Atlantic Ocean.

† See the instructions for Brazil by Commandant Mouchez.

In *January*, *February*, and *March*: At this season the winds between Bahia and 17° S.,* which should be crossed at 27° 30′ W., will vary from SE. to E. Beyond this parallel they will predominate from NE., allowing vessels almost always to run with a free wind to reach 25° S. at about 38° W.; after which the course continues as in Route Line to the Pacific, p. 141.

In *April*, *May*, and *June*, leaving Bahia, the winds will be found from SE., E., and NE., until the parallel of 17° S.* is attained. On the other hand, from 17° to 25° S., the winds will prevail from SW. to S. and SE., and will seldom blow from ENE. to NE. It will be important then to profit by these occasional winds, when they are met within the first part of the passage, by hauling close up so as to make all the easting possible on the port tack. Generally, 15° S. may be crossed at 36° 30′ W. If it can be crossed farther to the eastward, so much the better; but, if forced by the SE. winds to stand along the land, stormy winds from NW. and squalls from SW. may be encountered, and with these off-shore tacks should always be made; 25° S. should be crossed at 37° 30′ W., and the route continued as in Route Line to the Pacific, p. 141.

In *July*, *August*, and *September*, the prevailing winds between Bahia and 20° S. are more favorable at 50 or 60 leagues off shore,* so that the first thing to be done when leaving Bahia is to make all the easting possible. The prevailing winds will always be those from SE., only they will be variable to NE. at 150 miles from the land; while near the shore they will vary to the southward and westward. The route given in Route Line to the Pacific, p. 141, will generally be gained about the parallel of 20° or 25° S.

In *October*, *November*, and *December*, the winds blow almost constantly from E. and NE., and rarely from SE. There can be nothing easier then than, upon leaving Bahia, to steer so as to cross 20° S. at 37° 30′ W., and 29° S. at 40° W. Then to continue as in Route Line to the Pacific, p. 141.

Return route from Cape Horn or the Straits of Magellan to Bahia.—We have already, in Pacific to the line, p. 152, and Straits of Magellan to the line, p. 174, given the details of the route from the Pacific to the equator, for vessels which have come around the cape, or through the straits. We then said that vessels coming from Cape Horn, and especially sailing vessels, should not think of stopping at any place except Saint Helena or Port Stanley (Falklands). We also said that a call at Montevideo was exceedingly bad for them, because it would lengthen the route very considerably. (See Pacific to the line, p. 152.) Then, when speaking of the route for auxiliary steam vessels, starting from Cape Virgins, we showed that the call at Montevideo was the very best they could choose, and that, as stopping at Saint Helena would increase their route very much, they should avoid doing it. (See Straits

*See Southeast Trade Winds, p. 103, and Prevailing winds Africa, &c., p. 111, for the chances of weather in these localities.

of Magellan to the the line, p. 174.) But in no case did we fully examine the value of a call at Bahia, because at first it did not appear at all advantageous.

Auxiliary steam vessels starting from Cape Virgins, and bound to the line, should prefer the call at Bahia to that at Montevideo. The increase of distance is about the same in both cases. Only, the increase takes place so as to keep vessels in a fine-weather region when stopping at Bahia; while the stop at Montevideo keeps vessels for a longer time in a region of bad weather, particularly in July, August, and September, the season of pamperos. Sailing vessels coming from the Horn should not stop at Bahia, because Saint Helena is much nearer their route. But in case a vessel has orders not to stop at Saint Helena, and it is absolutely necessary to stop at some place in the South Atlantic, they should choose Bahia instead of Rio or Montevideo; but suppositions like the above do not apply in the least to ordinary navigation.

The preceding exceptions being admitted, we shall examine the route which should be followed by vessels returning from the Pacific, with express orders to stop at Bahia.

According to the season of the year, the advice given in Pacific to the line, p. 152, and Straits of Magellan to the line, p. 174, may be conformed to, as far as the point where the indicated course crosses the parallel of 20° S. We shall now see how the passage finishes.

In *January*, *February*, and *March:* This season will be adverse. *Auxiliary steam vessels* coming from Cape Virgins, and having crossed 20° S. at 26° 10′ or 26° 30′ W., should steer direct for Bahia. The winds will *always* be favorable; if they are persistent from N., so that no better than WNW. can be made, no uneasiness whatever need be felt, as the winds will certainly haul fair in proportion as the vessel gains more to the northward and westward. The same observations apply to *sailing ships* coming from the Horn. They should make a direct course for Bahia, with favorable winds, and without any chances of calms, from the time 20° S. shall have been crossed at 14° 10′ or 14° 40′ W.

In *April*, *May*, and *June*, auxiliary steam vessels coming from Cape Virgins should cross 20° S. at 27° 30′ W. From this point they should steer with constantly favorable winds, and without fear of calms, in such a way as to cross 17° 30′ S. at 30° W., and from there a direct route to Bahia.

Sailing vessels coming from the Horn should cross 25° S. at 17° 30′ W., as was said in Pacific to the line, p. 152; then 20° S. at 20° W., and from there should steer a direct route for Bahia, with favorable winds.

In *July*, *August*, and *September:* As was said in Routes Pacific to the Line, p. 152, and Straits of Magellan to the Line, p. 174, auxiliary steam, as also sailing vessels coming from Cape Virgins and Cape Horn, should all cross 30° S. in the vicinity of 27° 30′ W. From there

they may steer, as advised, in such a way as to reach the parallel of 25° S. in the quickest possible manner. Generally, this cannot be done to the westward of the meridian of 23° W.; but if it has to be crossed at 25° 20′ or 25° 40′ W., it will be all the better. In any case the winds will be favorable after passing 25° S. The course should then cross 20° S. at 30° W.; and from there lead direct to Bahia. In this season the passage will be made rather quickly.

In *October*, *November*, and *December*, auxiliary steamers from Cape Virgins have nothing to do but steer directly for Bahia, with favorable wind, and crossing 22° S. at 22° 30′ W.

Sailing vessels will find this season exceedingly bad for them. It will be best, after having reached 25° S. at 7° 30′ W., to follow our advice in Route, Pacific to the Line, p. 152, viz, to steer with well-established SE. trade-winds, so as to cross 20° S. at 10° W., and from there to make a direct route for Bahia, with constantly favorable winds.

Route from Bahia to the Cape of Good Hope.—In *January*, *February*, and *March*, leaving Bahia, the winds will, at first, prevail from SE., varying to E. and NE., with which vessels may stand down the coast to the southward and eastward, if possible, as far as the parallel of 16° or 17° S.; the winds will then haul to NE., and will predominate from that direction when between the parallels of 17° and 20° S., which last should be crossed about the meridian of 37° 10′ W. They will then continue to blow oftenest from NE., varying to E. and N., and permitting a course to be made *very easily*, so as to cross 30° S at 35° W., and 35° S. at 31° 10′ W. From this point, those vessels which are *bound to the Indian Ocean* should steer, with free winds, to cross 40° S. at 10° W., and may then continue their route as given in Route, Line to the Indian Ocean, p. 129. Vessels *bound to Table Bay* should steer to reach 37° 30′ S. at 20° W., and may make a quick run in longitude on this parallel, with the winds favorable. The passage ends as indicated in Route, Line to Cape of Good Hope, p. 137.

In *April*, *May*, and *June:* This is an unfavorable time for running down the coast of Brazil, as it is the season of the S. and SW. monsoons, which prevail between the parallels of 15° and 25° S., (see Southeast Trade Winds, p. 103). When speaking of the route from Bahia to Rio, it was said that in the months of May, June, July, and August, *sailing* vessels would be headed off; that they would have better chances of weather by keeping from 80 to 100 leagues off shore. This zone, into which vessels bound to Rio cannot enter, because it is necessary for them to draw in to the land about Cape Frio, is the one which should be preferred by vessels bound from Bahia to the Cape of Good Hope. They should also steer to cross the parallel of 25° S. at 37° 30′ W. From this point, the winds predominating from E. to NE. and to N., will permit a quick run to cross 30° S. at 35° W., and 35° S. at 22° 30′ W. Vessels *bound to the Indian Ocean* should then steer to

cross 39° 30′ S. at the meridian of Greenwich, and may continue their voyage as directed in Route, Line to the Indian Ocean, p. 129. Those bound to *Table Bay* should steer to reach the parallel of 37° 30′ S. at 12° 10′ W., and should then run down their longitude on that parallel. Their passage will end as indicated in Route, Line Cape of Good Hope, p. 137.

In *July*, *August*, and *September:* In this season, and particularly in the first two months, vessels will be very much retarded by opposing winds in their efforts to descend the coast.* They must run such a course, with winds from SW., SE., and NE., as will cross 25° S. at 37° 30′ W., as in the preceding season. They will then find the winds predominating from NE. and N., and rather frequent from SW. and E., with which they may easily steer to cross 30° S. at 35° W. The winds will then blow almost constantly from N. and NW., and advantage must be taken of them to cross 35° S. at 25° W. From this point the winds will always be favorable. Vessels *bound to the Indian Ocean* should run directly to cross the meridian of Greenwich between 40° and 40° 30′ S., terminating their voyage as directed in Route, Line to the Indian Ocean, p. 129). Those *bound to Table Bay* should steer so as to reach 37° 30′ S. at 13° W., about, and then run down the longitude on that parallel. Their passage should end as pointed out in Route, Line to Cape of Good Hope, p. 137.

In *October*, *November*, and *December:* The prevailing winds on the coast of Brazil at this season are from SE. to NE., and especially from the latter direction (see Southeast Trade Winds, p. 103). It will be easy then to run to cross 25° S. between 35° and 37° 30′ W., where the winds will be found blowing from SE. to NE., or N., predominating, however, from the latter two points and allowing 30° S. to be crossed at 35° W., and 35° S. at 31° 10′ W. From there the winds will be very favorable, and will vary from N. to W. and SW. Vessels *bound to the Indian Ocean* should cross the meridian of 25° W. at 35° S., and that of Greenwich at 41° S. This part of the route may be run with very great rapidity, and the whole ended as said in Route, Line to the Indian Ocean, p. 129. Vessels *bound to Table Bay* should also reach 37° 30′ S. between 23° and 25° W., and then continue their course as pointed out in Route Line to Cape of Good Hope, p. 137.

Route from the Cape of Good Hope to Bahia.—This route is, so to speak, entirely in the region of the trade-winds. The only question, then, which should arise is, how to steer to keep vessels in the best established winds, without sensibly increasing the distance to be run. It is also of some importance to carefully select the parallel at which it is best to cross the meridian of 30° W. It is well known that the general SE. winds prevailing to the westward of this meridian draw to the E. and NE. during the southern summer, and to the SE. during

* See what was said for the preceding season, and in the first part of Route Bahia to Rio, &c., p. 190.

the southern winter. Vessels will necessarily then enter this zone at a lower latitude during the months between September and April.

The following table contains the best points of crossing to follow, and it is usless to accompany them by any explanations. By conforming to them the winds will always be free:

Season in which the passage may be made.	Latitude at which it is best to cross the following meridians:					
	15° E.	5° E.	10° W.	20° W.	30° W.	35° W.
	South.	South.	South.	South.	South.	South.
	° ′	° ′	° ′	° ′	° ′	° ′
January, February, and March	32 30	27 00	21 00	18 25	15 30	14 20
April, May, and June	32 30	28 00	23 00	19 40	16 10	14 10
July, August, and September	32 30	27 00	22 30	19 20	16 05	14 20
October, November, and December	32 30	26 50	20 00	17 00	14 00	13 30

Route from Bahia or Pernambuco to Gaboon River.—In *January, February*, and *March, sailing-vessels leaving Bahia* will find the winds from the SE. varying to E., and sometimes to ENE. These winds will considerably modify the course of vessels; with SE. or ESE. winds the starboard tack must be taken; with the winds from E. or ENE., the port tacks should be brought aboard. In this way, and as the wind will be prevalent from SE., they may generally cross the meridian of 30° W. at 11° or 12° S. It would appear at first to be very advantageous to cross this meridian as far as possible to the southward, so as to gain well to windward with the SE. trades; but this is more an apparent than a real advantage, because between the meridians of 30° and 20° W., when to the northward of 10° S. the SE. trades vary to the southward, while to the southward of this parallel they vary to the eastward. As a rule, the points of 10° S. and 30° W. and 2° S. and 10° W. may always be joined on the chart by a straight line, and the rule of conduct will then be to *always keep to the southward of the line when possible.* Between the meridians of 20° and 10° W. the winds will blow constantly from SE., and the course of the vessel will be ENE. After reaching to the northward of 5° S., the equatorial current setting to the westward will be unfavorable.* It will then take a comparatively long time to reach 10° W.; but when it is reached between 1° and 5° S., the wind will soon haul to SSE. and SSW. At this point the voyage may be considered finished; the course should then be directly for the Gaboon, with the winds abeam or quartering.

At this same season *auxiliary-steam vessels*, with full sailing power, and able to sail within six points of the wind, will do well not to use their coal, because it will not shorten their voyage in proportion as it increases their expense. As for small steamers with poor sail-power,

* For the currents and also the direction of the trades, see Southeast trades, p. 103, and Currents South Atlantic, p. 116.

such as dispatch-boats, screw or paddle-wheel, all we can say is, that they should never undertake this passage, as it is beyond their powers.

Sailing-vessels or auxiliary steamers with good sail-power, leaving Pernambuco at this same season, will first find the winds from SE. but varying to E. until reaching the meridian of 35° W. With E. winds they should take the port and with SE. winds the starboard tack. The meridian of 33° W. will be crossed in the neighborhood of 8° S.; beyond 35° W., the winds being constant from SE., the course should be starboard tack ENE. as far as the meridian of 30° W., which should be crossed at 6° 30′ S. This point, and that on the equator marked by 15° W., should be joined on the chart by a straight line, and every effort should be made to keep to the southward of it. This recommendation is important to sailing ships, as also to those auxiliary steam vessels which do not desire to waste their coal;* we will add that it will be all the easier to conform to the route, as the SE. winds often haul to S. between the meridians of 30° and 20° W. After having crossed the line between 13° and 15° S. there will be 10 per cent. of calms and the SW. monsoon, with which a course must be run as quickly as possible to cross 2° N. at 10° W. In this part of the route, in case of calms, auxiliary-steam vessels may use their engines in order to reach the indicated point of crossing. The remainder of the passage may easily be made with the SW. monsoon varying to SE. (see Moonsoons of the Coast of Africa, p. 108), and by keeping in the favorable Guinea current (see Southeast trades, p. 103, and Currents South Atlantic, p. 116), according to the instructions contained in France to the Gaboon, p. 65, for the North Atlantic.

In *April*, *May*, and *June*, *sailing-vessels leaving Bahia* will find the winds from SE., ESE. and ENE. until the meridian of 35° W. is reached. The starboard tack should be taken with SE. and ESE. winds, and the port tack with those from E. and ENE. By working in this way 35° W. may generally be crossed between 11° 30′ and 12° S. Beyond this meridian the winds will always be found well established and blowing constantly from SE. Every effort should be made to get to the eastward by steering within 6½ points of the wind and "cracking on" to studding-sails if possible. The course should tend to cross the equator between 14° and 15° W., but not to the westward of the latter meridian. North of the equator southerly winds will be encountered, and with them it will be easy to run directly for the Gaboon River; however, since by steering as just said it will be necessary to work against the equatorial current which sets to the westward with great force, we think it would be best to lay a course for 3° N. and 10° W., and then to continue the route as laid down in Monsoons of the

* See chart of calms, p. 102; 31 per cent. of calms between 0° and 5° N. and 15° and 18° W.

Coast of Africa, p. 108, of the North Atlantic Ocean, and thus profit by the Guinea current, which is favorable. (See Currents South Atlantic, p. 116.)

The route just given applies to vessels of ordinary sailing qualities, as also to auxiliary steamers, because these latter may get up steam in case they experience a series of calms to the northward of the equator. But vessels with sharp lines and well masted, such as steam-frigates, clippers, and the like, may follow a very different route. They should lay close to the wind in the SE. trades, so as to gain the meridian of 10° W. at 1° 30′ S. From there they will find the winds variable from ESE. to SSW. (see Southeast trades, p. 103), and with them they may, if only slightly favored, overcome the current and make a direct or nearly direct course for the Gaboon River. They will not encounter any chances of calms until reaching the meridian of Greenwich.

Small screw or paddle-wheel gunboats, which are usually very poorly masted, will do well not to undertake this passage in this season. They will be still less able to make the voyage from Pernambuco to the Gaboon.

Sailing-ships leaving *Pernambuco* at this season should haul as close as possible to the wind on the starboard tack, and the SE. trades will last them until they reach the line. If carefully steered they should be able to cross the line to the eastward of 15° W. Above the line the winds will haul to the southward, and the voyage may end as indicated for vessels coming from Bahia. Auxiliary-steam vessels should do the same, except that in their case it is less important to hug the winds through the SE. trade regions. When they have crossed the line between 14° and 17° W. they will find southerly winds, and if they fall into a series of calms to the northward of the line, they should get up steam and run for 1° 30′ N. and 10° W. From this point they may run with the SW. monsoon and end their voyage, taking care to get into the favorable Gulf of Guinea current at 3° N. and 6° or 7° W.

In *July*, *August*, and *September:* This season will be extremely favorable for the passage from Bahia or Pernambuco to the Gaboon River, because when near and to the northward of the line the SW. monsoon will be well established, and without the least chance of calms.

Sailing-vessels leaving *Bahia* will find the winds from SE. variable to E., but with them they should always keep on the starboard tack. They may stand NNE. if necessary without the least cause of anxiety, unless the land is found too close aboard. If they are forced to cross 10° S. to the westward of 33° W. they need not be alarmed, because the winds will certainly haul to SE., and they may then make an ENE. course. In all cases, after passing the meridian of 30° W. (which should be crossed about 9° S.), the SE. trades will be very fresh and vary to the southward. Everything should then be set, and a good rap full should be kept so as to make all possible speed on the course. The

studding-sails may be set if the increase of speed is sufficient for the trouble of working them.

Vessels keeping close to the wind should cross 6° 30′ S. at 20° W., and 22° 30′ S. at 10° W.; and from there, with the winds hauling to SSE. and SSW., they may steer directly for the river, or nearly so, carrying sufficient sail to overcome the current. But, in our opinion, the advantage will be with that captain who, setting studding-sails and all possible sail, trims his ship for speed and then crosses 9° S. at 30° W.; 6° 20′ S. at 25° W.; 3° 15′ S. at 20° W.; the equator at 15° W., and 3° N. at 10° W. Between the line and this last point the winds will be southerly and fresh, without calms. Finally, the voyage will be ended by keeping in the favorable current of the Gulf of Guinea, as was said in Route France to the Gaboon, p. 65 of the instructions for the North Atlantic Ocean.

We repeat, this passage will be fine and easily made. Ordinary vessels may expect to make an average of 7 or 8 knots per hour through the whole of the voyage. The winds will be fresh and in a favorable direction, provided our advice has been followed; finally, no calms will be found to the northward of the line.

Small gun boats and all poor sea-going craft in general should not try this passage, as they do not sail within 7½ points of the wind. We may say that in this season this passage is always practicable. Very bad-sailing vessels being forced, in the first place, to cross the line at 18° W., will then find the winds from SE. hauling to S. and S.W., and with these last they may stand on, without any chances of encountering calms, to reach the strength of the favorable Guinea current.

Vessels leaving *Pernambuco*, in the same season of *July*, *August*, or *September*, will have the winds from SE. as far as the line, and with them they may steer a good full, so as to cross the equator at about 18° W. They will then have the winds from SE. to SW., and may profit by them to reach 3° N. at 10° W., terminating their voyage with the aid of the favorable Guinea current, as was previously pointed out.

In October, November, and December: This is not a favorable season; the passage will be long, and demands a great deal of attention.

Upon leaving Bahia, and in fact as far as the meridian of 30° W., the winds may be expected to predominate from ESE. to ENE., hauling at times to SE. The direction of the winds will regulate the board, and consequently the route. With southerly winds the starboard tack should be taken; and with east and northerly winds the port tack. As a general thing, in this way 10° S. may be crossed between 19° and 21° 20′ W.; it may be seen that it is best to cross this parallel at the farthest possible point to the eastward. From 10° S. vessels should haul by the wind through the steady SE. trades as far as 10° W., which must be crossed between 1° and 3° S. Fine vessels, well handled, may even cross this meridian at 3° 30′ S.; but in no case should vessels endeavor to beat into the wind and thereby diminish their speed in trying to ob-

tain a better result. After having passed 10° W. the winds will be from S., then SW., and without calms, up to the meridian of Greenwich, which should be crossed at or about 1° 30′ S. Beyond this meridian there will be 8 or 9 per cent. of calms, with winds from S., SW., and W., by the aid of which an east course may be run to 5° E. and 1° 30′ S. From this latter point, with the same favorable winds and *without a single chance of calms*, a course may be run to cross 1° S. at 7° 30′ E., and the equator about 7° 50′ E., whence the course may tend to the Gaboon.

Small steam gun boats, poorly masted, should, in the first place, steer to cross the equator at 15° W. They should then continue as we are about to point out for vessels coming from Pernambuco.

Vessels leaving *Pernambuco* at this season will find the winds varying from SE. to E. If they are of ordinary sailing qualities only, they should take the starboard tack when the wind is SE. or SE. by E., but when it hauls to ESE. or E. by S. they must take the port tack, and should keep it until they find themselves some 40 or 50 miles to the southward of the line joining Pernambuco and a point at 7° S. and 33° W. They may then go about, even with the wind from E., but should not stand to the northward of the line already spoken of. By maneuvering in this way they may cross 33° W. at 7° S., and should, if possible, cross it still farther to the southward. A vessel of good sailing qualities, or an auxiliary steamer, will be able to keep on the starboard tack even with east winds, and may thus cross the meridian of 33° W. at 6° or even 6° 30′ S. Beyond 33° W. they will find the winds constantly from SE., and with them they must stand on close-hauled. A sailing-vessel with fine lines may cross the equator at 15° W., or even farther to the eastward; generally it is crossed at 16° W. This question is of but little importance to auxiliary steamers, as they may light their fires when becalmed and steer for 3° N. and 10° W. But sailing-vessels will be interested in crossing the line to the eastward of 15° W., because they will only find about 9 per cent. of calms in that region, while to the westward there will be 18 per cent. of them. In all cases the prevailing winds to the northward of the line will be those from S., varying to SW., and it will be comparatively easy to reach the point already mentioned at 3° N. and 10° W., where the favorable Guinea current will be encountered. The winds will then be from SE., varying to S. and SW., and the voyage may easily be terminated as pointed out in Route France to the Gaboon, p. 65, of the North Atlantic instructions.

To sum up, the route will be long in this season, particularly from Pernambuco; because, after reaching the line at 15° or 16° W., by working against the equatorial current, the course passes through regions, to the northward of the line, of 10 to 15 per cent. of calms, to which vessels are constantly exposed until they reach the Gaboon.

Route from the Gaboon to Bahia.—This is one of the easiest passages that can be undertaken, as the wind is fair almost all the way. However, it is a mistake to suppose that in all seasons it is sufficient to simply head for the port of destination without making any other preparations at all. We shall proceed to point out, for each quarter, the recommendations which in our opinion are necessary to be followed to make a very quick passage.

In *January*, *February*, and *March*, when leaving the Gaboon, the winds will be found to predominate between SSW. and WSW., and with them vessels will be constrained to cross the meridian of 5° E. at 1° or 2° N., but in case they should have the good luck to encounter a series of NE. winds (which sometimes happens), they may steer to cross 5° E. at 0° 30′ or 1° S. When to the northward of the line, between 0° and 5° E., the wind will be from SSE. to SSW., with 7 per cent. of calms, while to the southward they will be variable from SSE. to SSW. and WSW., without a single chance of calms. In the first case the course should tend to cross the line between 0° and 1° W.; in the second, it should be between 1° and 2° S. so as to keep in the strongest part of the equatorial current; and if the winds are from WSW. the port tack must be taken, heading NW., because, when nearing the line, the winds will certainly haul to the southward, and reach SSW. or SSE. So soon as the meridian of Greenwich is reached, it will be necessary to make all possible headway with the southerly winds and the favorable current on a course that will cross 10° W. at 3° or 4° S., according to the prevalent winds. From this point the course should tend to cross 20° W. at 6° 30′ S.; then with the winds from SE., varying to the southward, to cross 30° W. at 10° S.; and from there, with winds from SE. hauling to E. and NE., the course should be direct to Bahia.

In *April*, *May*, and *June:* At this season the winds will predominate from S. to SW., with 14 per cent. of calms. It will be better for auxiliary-steam vessels to use their engines so as to reach the parallel of 1° S. in the neighborhood of 5° E. as soon as possible. Sailing vessels will generally be obliged to cross 5° E. at 1° or 2° N.; they will then encounter chances of more favorable weather, well-established S. or SW. winds, without any calms at all; they should then make every effort to cross the line at the meridian of Greenwich, or farther to the westward, if forced by SW. winds to do so. Below the equator the chances will be better. (See Southeast Trades, p. 103, and Monsoons of the coast of Africa, p. 108.) After getting into the zone comprised between the meridian of Greenwich and that of 10° W., and to the southward of the line, it will suffice to steer directly for Bahia, with the winds predominating from ESE. to SSE., or if the winds blow, as they sometimes do, from SSW., to stand to the westward as close-hauled as possible. In this way the meridian of 10° W. will generally be reached at 4° or 5° S.; and from there to Bahia the winds will be free,

blowing from SE., and hauling to ESE. and even NE., about the vicinity of the meridian of 32° or 33° W., which should be crossed ordinarily at 11° 40′ S.

In *July*, *August*, and *September:* At this season this passage is extremely easy to be made, as there is no chances whatever of encountering calms either to the northward or to the southward of the equator.

Leaving the Gaboon, when to the northward of the line, the winds will be found predominating from SSW. A westerly course may then be made with the port tacks aboard, and advantage must be taken of every slant so as to gain the parallel of 1° S. between 3° 40′ and 5° E. in the quickest possible time. If the wind hauls to SW., as it exceptionally does, the starboard tack must be taken so as to make southing. Sometimes it happens that the equator cannot be crossed to the eastward of 1° or 2° W., nor 1° S. to the eastward of 3° W.; in such a case the help of the equatorial current will be lost for a short time. The prevalent winds below the line and between the meridians of Greenwich and 10° W. are variable from SSW. to SSE., and will allow a course to be run which will cross 10° W. at 3° 30′ or 4° S. At this meridian of 10° W. (as also to the westward of it), the trades will be found well established from SE., and with them the course may be laid directly for the point where 13° S. is crossed by 37° W. From it the course may be laid directly for Bahia, as the winds will then predominate from SE., but may vary to SW., E., or NE.

In *October*, *November*, and *December* there will be an average of from 10 to 14 per cent. of calms to the northward of the equator, and to the southward only about 9 per cent.; and these all in the space between the meridian of Greenwich and that of 5° E. When leaving the Gaboon the winds will be found predominating from SW. to SSW., and varying from there as far as S.; finally, it will haul from S. to SE., at about 10° S. and 13° W. The general rule would then seem to be to take the *port tack* at the beginning of the voyage, when the winds are between SW. and S., taking care not to get to the northward of 2° N. On the other hand, the *starboard tack* should be taken if the winds blow to a point more to the westward than SW.; or, if they continue at SW., when the parallel of 2° N. shall have been reached.

After reaching to the westward of 5° W., when to the southward of the equator, the winds will be found constantly from the south with which the studding-sails may be carried, and the ship head W. by S., or even W., there being no necessity for making southing. After the meridian of 10° W. shall have been reached, the winds will haul to SE., so as to allow the course to trend more to the southward, and the ship to head for Bahia. The passage will end with winds blowing constantly from one or two points abaft the beam, permitting the ship to steer directly for the port of destination, as they will certainly haul to the E. and ENE. as the coast of Brazil is neared.

Route from the line to Rio.—We have no very extensive remarks to make upon this route, as it seems useless to repeat the advice already given in regard to certain portions of it in France to the equator, p. 71, and New York to the equator, p. 86, of our *instructions for navigating the North Atlantic Ocean*, and also in Route, Line to Bahia, p. 186, and Bahia to Rio, &c., p. 190, of these *instructions for navigating the South Atlantic Ocean.* In the first place we can only request the reader to refer to what is contained in the above-mentioned instructions, and then confine ourselves to the few following words:

After doubling Cape Saint Roque the winds ordinarily found, from *October* to *March*, on the coast of Brazil, will be found from NE. to ENE.; and these will bring the voyage to a speedy end, by permitting vessels to *stand along the coast at a convenient* distance. But from *March* to *October* the winds blow oftener between E. and SE.; so that, *in this season*, it is preferable to keep 40 *or* 50 *leagues offshore.**

We shall add, by way of completing our remarks, that there may be found in Calms, &c., p. 101, Southeast Trades, p. 103, and Prevailing winds of Africa, p. 111, some very useful information in regard to the percentage of calms and winds from different directions, which may be encountered on the Brazilian coast in the neighborhood of Rio de Janeiro. In addition, the following table contains the best points of crossings, and every one should endeavor to follow them as nearly as possible:

Season in which the passage may be made.	Longitude at which it is preferable to cross the parallels of—							Chances of calms to the westward of the meridian of 40° W. and to the northward of the parallel of 25° S.
	5° S.	10° S.	13° S.	16° S.	19° S.	21° S.	23° S.	
	W.	W.	W.	W.	W.	W.	W.	
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	
January, February, and March.....	30 00	32 30	34 24	36 40	38 24	39 24	41 10	13 per cent.
April, May, and June.....	29 48	31 50	33 20	35 00	36 30	37 24	39 18	13 per cent.
July, August, and September,... ...	28 00	31 10	32 24	33 48	35 30	36 40	39 10	9 per cent.
October, November, and December....	31 20	34 00	35 25	37 10	38 20	39 20	41 10	10 per cent.

Routes from Rio de Janeiro to Bahia, and from Rio de Janeiro to the line.†—*From Rio to Bahia:* This route, from *March* to *October*, is generally easy for sailing vessels, which stand up along the coast at 10, 20, or 30 leagues off shore. In the course of this season, and particularly in April, May, June, July, and August, when not beyond 40 or 50 leagues off the coast, vessels will find light and exceedingly vari-

* This passage is taken from our Traité de Navigation, page 504.

† See the instructions sur côte due Brézil, No. 367, du Dépôt, per M. le commandant Mouchez, pages 23, 24, and 25. The advice which he gave regarding the passage from Rio to Bahia, as well as that in the first part of the route from Bahia to Rio, is a *résumé* of the instructions of M. Mouchez.

able weather, heavy SW. rain-squalls, NW. thunder-storms, and unsteady breezes from E. and S. This season, then, is favorable for the passage of which we are now speaking. As we have already said, the course should not be so very far off shore, and the easterly board should not be too long, except when very fresh NE. winds are met with in the neighborhood of Capes Frio and Saint Thomé, and these, by the way, are of rather frequent occurrence. In this case they do not last longer than two or three days, and are replaced by calms and light airs from SW. and SE.

The months of *October*, *November*, *December*, *January*, and *February* are unfavorable for this passage. During this part of the year very fresh NE. winds will be encountered along the coast, and particularly in the locality of Cape Saint Thomè. Thus the port tack must be prolonged, with the ship's head E. or ESE., to about 150 or 200 miles off shore. At this distance the winds will be more favorable, and the strength of the adverse current will rapidly diminish. The vessels will then be in a good position to go about and take the starboard tack. The months of November and December are the very worst. It is at this time that the easterly boards have to be so long. But in October, January, and February, the easting strictly necessary is only the amount requisite to clear the Abrolhos Shoals. From the parallel of these islets the winds will vary from E. to E by S., and will nearly always permit Bahia to be reached by one board.

Full-powered steamers should keep the coast in view when running from Rio to Bahia. There is every advantage to be gained for them by passing inshore off the Abrolhos, where they will find, for about 20 leagues, a much lighter sea than outside. Further special and detailed instructions for this route will be found in the instructions of M. Mouchez, on pages 25, 28, and 29.

From Rio to the line.—*In January, February, and March*, when leaving Rio the winds will be found to predominate from E., NE., and NW., with a few chances of their blowing from SW. or SE., and besides this there will be about 13 per cent. of calms. It will generally be possible, under these conditions, to run so as to cross 24° or 24° 20′ S. at 40° W. The winds will then be from NE., but will haul to N., so that an E., or nearly E., course may be made with the port tacks aboard, and this should be done by keeping in the vicinity of the parallel of 24° S. until the meridian of 35° W. is reached. After passing this meridian the winds from SE. to NE. often haul to the northward, and the hope may be entertained of crossing 23° 30′ S. at 32° 30′ W; 25° S. at 30° W.; 22° S. at 28° 24′ W., and 20° S. at 26° W. From this point the SE. trades will ordinarily be found blowing from SE. to E., occasionally hauling to NE. and N., so with them a good run may be made with the starboard tacks aboard. If a series of NE. or N. winds should be encountered it will be necessary to go about and get on the port tack again; but these breezes will be of short duration. However, there is no cer-

tainty of finding the SE. trades well established until after the parallel of 15° S., which should be crossed in the vicinity of 25° W.

Those vessels which may be *bound to Europe* should cross the line, in January, at 24° 30′ W.; in February, at 24° W.; and in March at 24° 30′ W. Those *bound to the United States* should, as a general thing, cross 15° S. at 26° 10′ W., and the line at 30° 10′ W. Vessels *bound to the West Indies* should also cross 15° S. at 26° 10′ W.; then, with fair winds, they should steer to reach 10° S. at 30° W. and the line between 35° and 36° W.

In *April*, *May*, and *June* there will still be 13 per cent. of calms, with the winds predominating from NE. and E., and variable to SW., SE., and NW. These winds will generally force vessels down to the neighborhood of the parallel of 24° S., which should be reached about 40° or 41° W. From this meridian to that of 30° W., which last should be crossed at 23° 30′ S., the winds will be *exceedingly variable*, but predominating from between N. and SW., through E. We know of no other rule of conduct than the following: Make a true ENE. course when the direction of the winds will permit. In case of head winds, take the starboard tack, with southerly, ESE., E., and even ENE. breezes. But when the breeze hauls to the northward of ENE. the port tack should be taken, especially if a vessel finds herself still to the westward of the meridian of 35° or 36° W.; when about on that meridian the starboard tacks, with the head NNW., true, may still be kept aboard. Vessels should not, under any circumstances, unless actually forced there, get to the southward of 25° S. This is often done, expecting to find more favorable weather, but the fact is just the contrary, the chances being less favorable than on 24°, 23°, or 22° S. After having crossed 22° 30′ S. at 30° W., or near that, advantage may then be taken of the SE. trade-winds, which will then commence to be felt, to cross 20° S. at 27° 30′ W. Between 20° and 15° S. the trades vary from SE. to E., and sometimes to NE.; then from 15° to 10° S. they prevail from SE., hauling exceptionally to E. Finally, to the northward of 10° S. they blow fresh from SE.

Vessels *bound to Europe* should cross 10° S. at 26° W.; and the equator, in April and May, at 24° W., and in June at 23° 30′ W. Vessels *bound to the United States*, in this season, should cross 10° S. at 29° 15′ W., and the equator at 31° 10′ W. Those *bound to the West Indies* will cross 20° S. at about 29° W.; they should then steer with free winds to reach 10° S. at 31° 30′ W., and the equator at about 35° W.

In *July*, *August*, and *September*, when leaving Rio, there will be 9 per cent. of calms with the winds predominating from NE., variable at times from SW. to S., SE., E., and N. By the aid of these winds the parallel of 24° S. may generally be reached at the meridian of 40° W. From this meridian to that of 33° W., which should be crossed about 23° S., the winds will vary from SE. to N., and will predominate from NE.*

* See on this subject the remarks Southeast Trades, p. 103.

Between 33° and 30° W., which last should be crossed at 22° 30′ S., the winds will blow from SE. to NE., predominating at SE. Throughout all that part of the voyage, comprised between 40° and 30° W., every effort should be made to steer on a course following as near as possible the points of crossings which we have given, keeping on the starboard tack when the winds are from SE., E., and ENE. If the wind comes out from NE. before the parallel of 23° 30′ S. is reached, the ship's head should still be kept at NNW. on the starboard tack. But if the wind still holds at NE. after that parallel is reached, the port tack must be taken so as to head ESE. In this way the meridian of 30° W. may be crossed in the vicinity of 22° 30′ S. If vessels should be driven, without at the same time being forced to the eastward, to cross this meridian to the northward of 22° 30′ S., it will be so much the better; but if it must be crossed lower down, it will not be a matter of much concern. After getting to the eastward of 30° W. the winds will be found to blow almost constantly from SE. to E., and will permit 20° S. to be crossed at 29° W., and 15° S. at 27° 30′ W. If a series of NE. winds should be encountered, as is sometimes the case when to the southward of 20° S., the vessels should be steered close-hauled on the starboard tack until the wind veers to E. and SE., which will allow the points of crossing to be followed.

Vessels *bound to Europe* should cross the line between 24° and 24° 30′ W., and the parallel of 5° N. at the longitude indicated for each season of the year, as given in Route Equator to France, p. 78, of the *instructions for navigating the North Atlantic Ocean.* Between 0° and 5° N. the winds will be from S. and SE., without calms. Vessels *bound to the United States* should, as we have already said, cross the parallel of 15° S. at 27° 30′ W.; and from this point steer, with the SE. trades well established, to make a true north course on the meridian of 27° 30′ W., on which they should also cross the equator and the parallel of 5° N. Between the equator and 5° N. the wind will be variable from S. to SE., without calms.

Vessels *bound to the West Indies* should follow the route as given from Rio to 20° S., with the single exception that they should keep the starboard tacks aboard much longer in case of encountering NE. winds; they should cross 20° S. between 29° and 31° W. From this point they should make a direct course, with favorable winds, to cross 10° S. at 32° W. From there they should steer to pass about 50 miles off shore of Cape Saint Roque, and then cross the equator at 37° 30′ W.

In *October*, *November*, and *December*, the winds will be from SE. to NE., but will predominate from NE. from the time of leaving Rio de Janeiro until the parallel of 20° S. is reached. There will also be 10 per cent. of calms between Rio and the meridian of 40° W., which should, as a general thing, be crossed at 24° S. The winds being then from NE. principally, will generally prevent vessels reaching 23° S. to the westward of 34° W., or 22° 30′ S. to the northward of 30° W. The

parallel of 20° S. may then be crossed between 27° and 29° W., according to the favorable or unfavorable direction of the winds, which will be found to vary from SE. to E., NE., and N. Between 20° and 15° S. the winds will predominate from SE. to NE., and a course may be steered, as nearly as possible, to cross 15° S. in the vicinity of 27° 30′ W. if the vessel is bound to Europe, and about the meridian of 28° 50′ W. if she is bound to the United States or the West Indies. Beyond the the parallel of 15° S. the trades blow constantly from SE., varying to E.

Vessels *bound to Europe* should cross the equator in October and November between 22° and 24° W., and in December between 23° and 25° W. Those *bound to the United States* should cross the line at 30° W. Finally, vessels *bound to the West Indies* should steer to pass about 50 miles off shore of Cape Saint Roque, and then to cross the equator toward 37° 30′ or 38° W.

Routes from Rio to Montevideo and from Rio to Cape Horn.—(1) *From Rio to Montevideo:* The following table gives the best points of crossings to follow when making the passage from Rio to Montevideo. This may usually be done with favorable winds, and the principal things to contend with are the chances of the calms, which are inconvenient to sailing vessels, and will surely be encountered if they keep too far off the route indicated in the table, and the *pamperos*, or heavy SW. gales, which may be expected between July and October. Following the table there are some remarks concerning the principal circumstances accompanying this voyage for each season; also upon the land-fall at the mouth of the Rio de la Plata:

Season in which the passage may be made.	Longitude at which it is preferable to cross the following parallels of latitude:					
	25° S.	27° S.	29° S.	31° S.	33° S.	34° S.
	W. long.	W. long.	W. long.	W. long.	W. long.	W. long.
	° ′	° ′	° ′	° ′	° ′	° ′
January, February, and March	43 10	43 24	44 30	46 50	50 15	52 25
April, May, and June	43 40	45 40	45 58	47 30	51 06	52 25
July, August, and September	44 00	44 30	45 00	47 30	49 50	51 00
October, November, and December	43 12	44 20	45 30	47 48	50 00	52 25

In *January*, *February*, and *March*, the route as indicated in the table applies particularly to sailing vessels. By following it they avoid the zone comprised between the parallels of 25° and 30° S., and the coast of Brazil and the meridian of 45° W., in which there are 24 per cent. of chances of calms. To sum up, by following the route whose points of crossings we have indicated, vessels may expect to have 75 per cent. of favorable winds; that is, from E., NE., and N. Northeast and easterly breezes will generally be found at the mouth of the river. (See Winds Coast of Africa, p. 110.

In *April*, *May*, and *June*, the winds will still be fair most of the time. The object of the *détour* which our route indicates, and which sailing vessels may make even more marked, is, as in the preceding season, to avoid the zone already spoken of, in which 23 per cent. of calms may be encountered.* When making the mouth of the river at this season of the year, westerly and southwesterly winds will be encountered more frequently than at any other, and these often accompanied by heavy southerly squalls, which may prevent sighting the land at the time of entering the river. On this subject we advise consulting what has been said in Winds Coast of Africa, p. 110.

In *July*, *August*, and *September*, by following the route given, the winds will be favorable almost all the time until the parallel of 30° S. is reached. They will generally be rather good from 30° S., crossed at 46° 24′ W., to 33° 05′ S., crossed at 50° W.; nevertheless, during this fraction of the voyage about 20 per cent. of those from SW. may be counted on. After passing to the westward of the meridian of 50° W., vessels will be exposed to 25 per cent. of SW. winds, and consequently may be very much delayed. *Pamperos*, or SW. gales, *suestadas*, or SE. gales (see Winds, Coast of Africa, p. 102), fogs, and bad weather generally are to be feared during this season off the mouth of the river. Calms, which from January to June constitute the chief difficulty of the passage from Rio to Montevideo, are much less frequent from July to October.

In *October*, *November*, and *December:* At this season the passage will be made under rather favorable circumstances. The prevailing winds will be those from SE. to E. and NE. The chances of calms will be but few (see p. 102), if the precaution is taken to avoid getting to the westward of the route as indicated in the table. At the mouth of the Plata River the winds will be from NE. (see Winds Coast of Africa, p. 110), and when near the land from E. and SE. during the day and from NNW. during the night.

General remarks upon making the land at the mouth of the river Plata:† At the mouth of the river the prevailing winds *during the summer*, that is from *September* to *March*, are those from NE., which are accompanied by a very clear atmosphere overhead, but haze and fog around the horizon. These winds haul to the eastward as they ascend the river, and at this season, near full and change, there are often very strong SE. winds, accompanied by rain and bad weather. At Buenos Ayres, *during the summer*, the SE. winds are usually fresh during the day and haul to the northward during the night. In the *winter months*, from *March* to *September*, the prevailing winds at the mouth of the river are those from SW. to W.; but higher up the river they are oftener from the northward than the southward of W. At Buenos Ayres

* For the chances of calms the table p. 102 should be consulted.

† See first part of Horsburgh, No. 332 du Dépôt, page 91. What is here given is from the instructions of Captains Heywood, Bouverie, and James Horsburgh.

the weather is finest in winter, because, the winds being from NW. to SW., the sea is smooth there, and communication with the shore is easy.

Outside the river, and especially about Cape Santa Maria, the winds are generally from NE. and N., except during SE. gales (in summer) and those from SW. (in winter), which blow about the time of the new and full moon. Consequently, vessels about making the land should endeavor to do so about the latitude of that cape, viz, 34° 40′ S.

According to Captain Bouverie, vessels standing in for the land, with winds from N. or NE., would do well to keep on the parallel of Cape Santa Maria, or a little farther to the northward, until they get soundings, because the current sets to the SW. But it is not well to try to make the land very far to the northward of the cape, because, although there is in reality no danger, still there are certain shoals lying off the land which might be a cause of anxiety to a stranger.

Horsburgh also considers it preferable to make the land in the neighborhood of Cape Santa Maria; nevertheless, if the wind is between SE. and NNE., vessels should enter the river passing to the northward of the English bank and either side of Lobos, according to the state of the weather. Between Lobos and the mainland there is a fine passage, with 14 fathoms water.

From Rio to Cape Horn: In *January*, *February*, and *March*, when starting out on this voyage, the course is the same for a short time as that given in the table for the passage to Montevideo; that is, as far as 30° S., crossed at 45° W. From this point it should be laid to cross 40° S. at 57° 30′ W.

Between 30° and 35° S., crossed respectively at 45° and 51° W., the winds will nearly always be favorable. There will be altogether about 8 per cent. of SW. winds, with which a SSE. course may be made; when this hauls to S. vessels should go about; the SW. winds will be followed by a long series of SE., E., and NE. winds, which will permit vessels to reach the indicated points of crossings.

From the parallel of 35° S. to that of 40° S., which should be crossed at about 57° 30′ W., the winds will predominate from NE. and N., and will frequently be from W. and SW. Vessels should therefore profit by series of SE., E., NE., N., and NW. winds to make westing and to get well to the westward of the line, joining our points of crossing. When the NW. wind hauls to W. the yards should be braced up, and kept trimmed until they are sharp up; vessels may then stand on close-hauled so long as the wind keeps at SW. So soon as it hauls to the southward of that they should go about, as the wind will not remain any length of time at south, but will soon change to SE. and E. and become favorable.

Between 40° S. and the Horn the instructions given in Route, Line to the Pacific, p. 141, should be followed.

In *April*, *May*, and *June*, when leaving Rio, the course should be laid to cross 25° S. at about 44° W. From there it will be best to make a course to cross 30° S. at 45° W., but not any farther to the westward. Between 25° and 30° S. the prevailing winds will be those from SE. to E., NE., and N.; that is to say, favorable. Nevertheless, there will also be 10 per cent. of chances of calms and 10 per cent. of chances of SW. winds. With southerly winds the port tack should be taken, and with those from SW. the starboard.

Leaving 30° S. the course should be to cross 35° S. at 50° W., as the winds will blow almost constantly from NE. to N. and NW. At most there will be but 18 or 20 per cent. of SW. winds, and with them the starboard tack should be taken, to head SSE.; when on this course the tack should be changed so soon as the winds haul to SSE. and SE., which, by the way, will soon take place. With steady weather and a well-established northerly breeze, vessels should not try to cross 36° S. to the westward of 50° W.

After crossing 35° S. there will be about 60 per cent. of chances in favor of fair winds, and the other 40 per cent. of chances in favor of S. and SW. breezes. With the N. and NW. winds a good run on the course should be made, by taking care to keep to the westward of the line, traced on the chart, joining the points of crossings. When the winds haul to W. the yards should be braced up, and the vessel kept close-hauled so long as the winds remain at W., WSW., or SW. by S. She should not go about until the wind will allow a true west course to be made on the port tack. So soon as that can be done the tack should immediately be changed. By maneuvering in this way vessels may be able to cross the meridian of 55° W. at 38° 30′ or 39° S.; this will be a very favorable circumstance, as they can work down the Patagonian coast all the better the nearer they are to the land. However, as a general rule, 55° W. is hardly ever reached to the northward of 40° S.

The remainder of the voyage is made according to the instructions given in Route, Line to the Pacific, p. 141.

In *July*, *August*, and *September:* This is the season of SE. and SW. gales on the coast of Brazil and off the Plata River. The course from Rio to the parallel of 34° S., which should be crossed at 51° W., is the same for vessels bound to the Horn as for those bound to Montevideo.

Leaving the parallel of 34° S. the course should be laid to cross 40° S. at about 57° 30′ W. In this part of the route the winds will be more favorable the nearer inshore a vessel may happen to be. A line may then be drawn on the chart joining the points at which 34° and 40° S. are to be crossed as already indicated, and care should be taken to keep to the westward of this line so long as the weather permits its being done. There are about 60 per cent. of chances of very favorable winds, *i. e.*, from SE., NE., N., and NW., and 40 per cent. of those from SW. and S. With westerly winds the starboard tack should be kept until by hauling to SSW. they will permit a true west course being

made on the port tack. On this tack vessels may stand on with the wind at S., making a WSW. course, until they reach the line joining the points of crossing on the chart. If the wind still holds at S. when that line is reached, the tack should immediately be changed again so as to run ESE. In this way when the winds haul to SSE., which will soon occur, the land will not be close enough aboard to cause any uneasiness about taking the port tack again and making a good run to the SW. This remark applies to that fraction of our route comprised between 37° and 39° S., during which vessels will not be more than 80 or 100 miles from the land, which, by the way, might appear a little close at this season of the year, during which SE. and SW. gales may be expected.

Beyond 40° S. the voyage to the Horn is the same as that given in Route, Line to the Pacific, p. 141.

In *October*, *November*, and *December*, lines may drawn on the chart joining the following points: 25° S. at 43° 12′ W.; 29° S. at 45° W.; 35° S. at 50° 30′ W.; 40° S. at 55° W.; 43° S. at 60° W., and the remainder as given in Route Line to the Pacific Ocean, p. 141. The route thus obtained will be the one which it will be preferable to conform to.

Between Rio and 29° S. the winds will nearly always be favorable. Nevertheless, if the wind should come out from SW. the choice of the tack is not a matter of indifference; the port tack is to be preferred so long as it does not lead to the westward of the meridian of 45° W., while still to the northward of 29° S.; because in that locality there are 11 per cent. of chances of calms.

From 29° to 35° S. the winds blow oftenest from NE. to N. It is but rare that SW. breezes are found; but with them vessels will be constrained to take the starboard tack close-hauled.

From 35° to 40° S. there will be at least 70 per cent. of chances of favorable winds from SE. to NE., N., and NW., about 6 per cent. of calms, and from 20 to 24 per cent. of S. and SW. winds. With SW. winds the starboard tacks must be brought aboard, and with those from S. the port tacks. There is not the slightest danger in prolonging the port tack, yet great care should be taken to avoid passing to the westward of the meridian 55° W. when to the northward of 40° S., because that is a zone of 16 per cent. of calms.

Beyond 40° S. the instructions in Route, Line to the Pacific Ocean, p. 141, and which will now be given *en résumé*, should be followed, viz: Do not neglect a chance to make westing, and thereby approach the coast of Patagonia, while making a run toward the points of crossing indicated: 43° S. at 60°, or farther to the westward; 45° S. at 61° 10′, or farther to the westward, and so on.

CHAPTER VIII.

Route from Cape Horn or the Straits of Magellan to Rio de Janeiro.—The question presented for discussion in this section is the examination of the best route from either Cape Horn or the eastern entrance of the Straits of Magellan to the port of Rio de Janerio. We do not intend here to dilate upon the question of the comparative value of Rio as a stopping place for vessels returning to the North Atlantic from the Pacific Ocean. A detailed discussion of the subject may be found in Route, Pacific to the line, p. 152, and Route Straits of Magellan to the line, p. 174, as also in the first part of Route Cape Horn to Bahia, p. 191. We shall sum up by saying that Montevideo and Bahia appear to be the best calling ports for auxiliary-steam vessels *en route* from the Straits of Magellan to either Europe or the United States; while, on the other hand, either Port Stanley (Falklands) or Saint Helena is preferable for sailing vessels which have doubled Cape Horn proper. However, it may be best to compare the routes (for each season of the year) as indicated in this as well as in Route, Rio to line, p. 203, with those given in Route, Pacific to the line, p. 152, Route, Straits of Magellan to the line, p. 174, Route, Bahia to the line, p. 188, Route, Cape Horn to Bahia, p. 191, and finally Route, Montevideo to the line, p. 221, and Route, Cape Horn to Montevideo, p. 230. In this way the reader may become familiar with the different advantages and disadvantages of a call at Rio, Saint Helena, Bahia, or Montevideo.

Whatever may be the actual state of affairs, we shall suppose, for the present, that it becomes necessary for a vessel when returning from the Pacific to touch at Rio; and we shall proceed to give, for each season, what appears to us to be the best route to be followed.

In *January*, *February*, and *March*, auxiliary-steam vessels leaving Cape Virgins should follow, as far as the parallel of 30° S., exactly the same route as they would were they bound to Europe direct. (See Route, Straits of Magellan to the line, p. 174.) They should then endeavor to cross 30° S. between 30° and 31° 10′ W. (but never to the westward of this latter meridian unless forced by stress of weather); at this point only will they find themselves sufficiently far to windward to allow them to steer for Rio, or at least for the point at 23° 30′ S. and 40° W. In this fraction of the voyage, they will predominate between E. and N., varying to SE., E., NE., N., and NW. Vessels will most always be on the starboard tack: except, of course, when they have occasional NW. or SW. winds; at all times it will be advantageous to steer about a point to the northward of the course which would lead directly to the

point of crossing already given. From this point the course should be direct for Rio, and may generally be made with E. or NE., and, consequently, quartering winds. There will, however, be about 13 per cent. of calms to be overcome in this last part of the passage.

In this *same season* sailing vessels coming from Cape Horn should cross 52° S. in the vicinity of 55° W., and then make a direct course, with the winds nearly always favorable, as they predominate from the westward, in such a way as to cross 40° S. between 39° and 40° W., and 34° S. at 31° W. As a general rule, vessels should run a true north course, as nearly as possible, as far as 30° S. In that part of the passage between 34° and 30° S., vessels will often be very much retarded by winds predominating from N. and NW.; however, favorable winds may be encountered; that is, those from S., SE., and E., as also those from NE., which last are not so very bad, as they permit a NNW. course to be run. We shall also recommend, in case of head winds, that vessels do not get to the eastward of the meridian of 30° W., at least unless they are forced there, as in that locality there are 9 per cent. of chances in favor of calms. By maneuvering in this way, the parallel of 30° S. may be crossed in the vicinity of 31° W. The remainder of the passage will be made in the same way as pointed out for auxiliary-steam vessels; but this will be the easier the farther to the eastward 30° S. may have been crossed. Vessels which have had contrary winds to contend against before reaching the parallel of 30° S. will sometimes find themselves obliged to cross that parallel at 32° or 33°, or even farther to the westward. In that case, of course the latter part of the passage will be the more difficult to make the more unfavorable that point of crossing may have been, as winds from N. and NE. will predominate between the parallels of 30° and 24° S.

In *April*, *May*, and *June*, auxiliary steamers leaving Cape Virgins should follow the route given in Route Straits of Magellan to the line, p. 174, as if they were bound to Europe, and in that way cross the parallel of 30° S. in the neighborhood of 34° W. From there to 23° 30′ S., which they will be forced to cross between 35° and 36° W., the winds will vary from SW. to SE., E., NE., and N., and occasionally to NW.; but they will predominate from between SE. and N. In this portion of the passage it should be proposed to make all the northing possible without trying to gain to the westward. After having crossed 25° 30′ S. in the vicinity of 35° W., the course should be laid to cross 23° 30′ S. at 40° W.; this may generally be easily done, as the winds, although varying from SW. to N., through E., will predominate from SE. to NE. The NW. or head winds will be extremely rare. After passing to the westward of 40° W., and up to Rio, in fact, the winds will blow at times from between SW. and SE.; but will rather predominate from E. to NE., hauling, at times, to NW.; there are also 13 per cent. of calms to be expected. As a general thing, however, the latter part of the voyage may be accomplished with great ease.

Sailing vessels leaving Cape Horn, in *this same season*, should cross, successively, 52° 30′ S. at 55° W.; 48° S. at 50° W.; 40° S. at 42° 30′ W., and 30° S. at 34° W. In this portion of the route the winds will predominate from NW. to SW., and consequently will generally be favorable. Between 30° S. and Rio vessels should follow the same points of crossings as given for vessels which have come from the Straits of Magellan.

In *July*, *August*, and *September*, auxiliary steamers coming from the straits, and sailing vessels from Cape Horn, should conform to the directions laid down in Route, Straits of Magellan to line, p. 174, and Route Pacific to the line, p. 152, by following, as far as the parallel of 30° S., the same route as they would were they bound to the line on their way to Europe or the United States. Thus, they should cross 30° S. in the vicinity of 35° W., and from this point should endeavor to make all the northing possible, so as to reach 30° S. between the meridians of 34° and 36° 30′ W. In that portion of the passage lying between 35° and 30° S., the winds will predominate from N. and NW., and will blow rather frequently from SW., S., and SE. If a series of N. winds is encountered, vessels should brace sharp up on the starboard tack, and remain so until the wind hauls to NNW., but at the same time bearing in mind that the run should not extend to the westward of the meridian of 39° W. When the wind hauls to NNW. vessels should go about; and soon after it will haul to NW., W., &c., and coming to the eastward will permit northing to be made all this time. We shall repeat, that every advantage is to be gained by crossing 30° S. as far as possible to the eastward, so long as it is not to the eastward of 34° W.

From 30° to 25° S. the winds will predominate from SE. to N., through E. In case the winds will permit, it will be best to steer to cross 28° S. at 36° W.; 26° S. at 37° 30′ W., and 24° S. at 40° W. But in case northerly winds are encountered vessels should come close to the wind on the starboard tack, and run WNW. so long as they are to the eastward of the meridian of 38° W.; upon reaching this meridian, if the wind still holds at N., vessels should go about immediately. This event will be of rare occurrence. In ordinary cases, northerly winds will have hauled to the westward long before the meridian of 38° W. is reached; and of course with this change of wind the tack must also be changed.

After crossing 24° S. at 40° W., the winds will be found to predominate from NE., though often hauling from SW. to SE., E., NE., and N.; the chances of calms are only 8 or 9 per cent.; so the passage may usually be finished with ordinary facility.

In *October*, *November*, and *December*, auxiliary steam vessels, after leaving Cape Virgins, will find it advantageous to cross, successively, 50° S. at 62° 30′ W.; 45° S. at 50° W.; 40° S. at 40° W., and 35° S. at 37° 30′ W.

Sailing vessels leaving Cape Horn should, as a general thing, steer to cross, successively, 50° S. at 51° 10′ W.; 40° S. at 37° 30′ W., and 35° S. at the same longitude. The winds will nearly always be favorable in this first part of the route. In case they are contrary, the port tack making the most easting should be preferred, but understanding at the same time that no southing should be made.

Arrived at 35° S. and 37° 30′ W., the course should be laid to cross, if possible, 30° S. in the neighborhood of 39° W. The winds will then be found extremely variable, but withal favorable, and with them this portion of the passage may be made.

Leaving 30° S., crossed at 39° W., vessels should, if the winds permit, make a direct course for Rio. In case the wind hauls to N., which may be expected 40 times in 100, so long as vessels are to the eastward of 40° W., they should take the starboard tack and stand on to the westward of this meridian, where winds will be found predominating from S. to SE. and NE., with which it will be easy to steer direct for Rio. In this way the voyage may end, with winds at SE. to NE.; remembering that 10 per cent. of calms may be counted on after passing the parallel of 25° S.

Route from Rio de Janeiro to the Cape of Good Hope.—Upon leaving Rio, in *January*, *February*, and *March*, as far as the parallel of 25° S., crossed between 41° and 42° W., there will be 13 per cent. of calms, with the winds from E. to NE. Beyond this point there will generally be better established winds, varying from E. to NE. and N., and with them the course may be laid to cross 30° S. between 37° and 39° W., but as near as possible to 37° W. Between 30° and 35° S., which latter should be crossed between 31° and 33° W., the winds will predominate from N. and NW., and consequently be favorable. The rest of the passage may easily be made, crossing 37° S. between 20° and 24° W., then making easting by following the instructions contained in Route, Bahia to Cape of Good Hope, p. 193, Route, line to the Indian Ocean, p. 129, and Route line to Cape of Good Hope, p. 137, which spoke of the voyage to Cape Town or the Indian Ocean.

In April, May, and June: In this season from 12 to 13 per cent. of calms may be counted on when to the westward of the meridian of 40° W.; the first thing then requiring attention is to make all possible easting, and but little southing. Unfortunately, the winds generally prevail at E. and NE., so that it is seldom that sailing vessels can cross 40° W. to the northward of 25° 30′ or 26° S. Whenever that meridian is reached the winds will, in all cases, be found to be more favorable, as they are better established and prevail from the northward, although at the same time they are rather variable from SW. to S. and SE., E., N., and NW., with only 4 per cent. of calms. Consequently it will generally be quite easy to cross 30° S. in the vicinity of 35° W.; nevertheless, as it may happen that a series of S. or SE. winds are felt, it will be prudent to profit by all favorable winds by getting a little to the

southward of the route. Thus, for example, the winds permitting, 27° S. may be crossed at 39° W.; 29° S. at 37° W., and 30° S. at 36° W. In this part of the route the starboard tack should be taken with S., and the port tack with SE. winds.

Having crossed 30° S. between 35° and 36° W., the course should be, with generally favorable winds, from NE., N., and NW., to cross 33° S. at 30° W., and then 35° S. at 22° 30′ W. If a series of easterly winds are met with in this part of the course, the southerly tack will always be the more advantageous.

Beyond the parallel of 35° S., the instructions in Route, Bahia to Cape of Good Hope, p. 193, or Route, line to Indian Ocean, p. 129, and Route, line to Cape of Good Hope, p. 137, must be followed according as vessels are bound to Cape Town or the Indian Ocean.

In July, August, and September: At this season not more than 8 or 9 per cent. of calms will be met with in the space between Rio and 40° W., and the winds will predominate from the NE., permitting that meridian to be crossed at 25° S. Beyond the above-named meridian no more calms need be feared, and the winds will be found most frequently from NE. and N., although they will also be rather frequent from SW. and E. With these winds it will be easy to steer so as to cross 30° S. at 35° W. The winds will then predominate principally from N. and NW., advantage of which should be taken to cross 35° S. at 25° W. From this point the winds will always be favorable.

Vessels bound up the Indian Ocean should run directly to cross the meridian of Greenwich between 40° and 40° 30′ S., and may end their voyage as was directed in route Line to Indian Ocean, p. 129. Those bound to Cape Town should steer so as to reach 37° 30′ S. at about 15° W., and should then keep on this parallel to run down their easting. The voyage should end as was pointed out in Route Line to Cape of Good Hope, p. 137.

In *October, November,* and *December*, along the first part of the voyage, as far as the meridian of 40° W., there will be about 9 or 10 per cent. of calms to be encountered. At first the winds will be variable from SW., S., SE., E., and NE., but they will predominate from SE. and NE. The farther the vessel gets to the eastward the more will the winds prevail from NE. and N.; or, in other words, the more favorable will they become. The rule of conduct will then be to make all the easting possible, even though obliged at the same time to make a little northing, so as to get to the eastward of the meridian of 40° W. in the quickest time possible. As a general thing this meridian will be crossed at 24° 30′ or 25° S.

Beyond this point of crossing the winds will be found to prevail from SE., NE., and N., and especially from the latter two directions, permitting the following crossings successively to be made: 30° S. at 35° W. and 35° S. at 31° 10′ W. After passing the parallel of 35° S. the winds will be found very favorable, and blowing principally from N. to W. and SW.

Vessels bound up the Indian Ocean should cross 25° W. at 35° S., and the meridian of Greenwich at 41° S. This part of the voyage may be made very quickly, and the passage should then be finished up as was directed in Route, Line to Indian Ocean, p. 129. Vessels bound to Table Bay (Cape Town) should also reach 37° 30′ S. between 23° and 25° W., and may then finish their voyage in the manner pointed out in Route, Line to Cape of Good Hope, p. 137.

Route from the Cape of Good Hope to Rio de Janeiro.—This voyage is very easy, as it lies almost all the way in the region of the SE. trade-winds. It is important, however, to determine the route to be followed when passing through the regions of poorly established or variable winds, in order to avoid, particularly in the southern summer, the regions of calms lying between 20° and 30° S. and to the westward of 10° or 15° W. It will be well also to be careful in the choice of the parallel at which to cross the meridians of 35° and 40° W. On this subject we shall remind the reader that the general winds prevailing in the western part of the SE. trade region are those from E. and NE. during the southern summer months; while on the contrary they are from SE. during the southern winter. From this it will be seen that it is preferable from September to April to run the latter part of the voyage on a lower latitude than during the remainder of the year.

The following table gives the best points of crossing to be followed, and it seems to us unnecessary to accompany it with a single word of explanation. By conforming to the tacks therein indicated the winds will nearly always be fair:

Season in which the voyage may be made.	Latitude at which it is preferable to cross the following meridians:									
	15° E.	5° E.	Greenwich.	10° W.	15° W.	20° W.	25° W.	30° W.	35° W.	40° W.
	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
January, February, and March	32 30	28 05	26 15	22 30	20 30	20 30	20 30	21 25	22 15	23 00
April, May, and June	32 30	28 00	26 30	23 30	23 00	23 06	23 12	23 18	23 24	23 30
July, August, and September	32 30	27 00	26 10	24 30	24 20	24 10	24 00	23 50	23 40	23 30
October, November, and December	32 30	27 00	24 25	21 00	21 15	21 30	21 52	22 14	22 37	23 30

From Rio de Janeiro to the Gaboon River.—The beginning of this voyage, that is, from Rio to the SE. trades, is *always* made by following the directions given in for vessels bound from Rio to the line, p. 203. We shall proceed to make a few remarks in regard to the latter part of the passage.

In *January*, *February*, and *March*, after having arrived at 20° S. somewhere between 25° and 25° 30′ W., the winds will be found to predominate from SE, but variable to E., NE., and N. With E. and SE. winds, vessels should haul close to the wind on the starboard tack; with those

from NE. and N., they must do the same on the port tack. In this way the meridian of 20° W. will be crossed somewhere between 17° and 19° S. From this point the SE. trades will be definitely established, and will permit a good run to be made with the sails rap full, so that the meridian of Greenwich may be crossed at about 8° S. From that point to the Gaboon the winds will be from SSE. to SSW., SW., and W., interspersed with only 4 per cent. of calms, and these last will not be met with until after the meridian of 5° E. shall have been passed. The voyage may then be easily finished; we must repeat, however, that in the calculations for the voyage both the drift current of the trades and the equatorial current must be taken into account, particularly in the latter part of the voyage (see Currents South Atlantic, p. 116).

In *April May*, and *June:* After having crossed 20° S. at 27° 30′ W. the winds will be found to predominate from SE., but varying at times to E., and even NE., and with them 15° S. may generally be crossed near 22° 10′ W. But in all cases, after 15° S. is passed, well-established SE. winds may be counted on, which will permit, by keeping a good full, the crossing of 10° W. somewhere between 8° and 9° S. Beyond this point of crossing the winds will be variable from ESE. to SSE. and SSW., and a good run may be made on the starboard tack, and without experiencing calms, as far as the meridian of Greenwich, which may be crossed about 3° 30′ S., and also 5° E., which may be crossed at 1° S. To the eastward of this last meridian the chances of calms are 14 per cent., and the winds will predominate from S. to SW.; the passage may then be easily brought to an end, and especially by auxiliary-steam vessels, which may get up steam when beset with calms.

In *July*, *August*, and *September* the parallel of 20° S. may generally be crossed somewhere between 28° and 29° W. From this point the course may be laid directly for the Gaboon, by heading NE. by E. ½ E., true, with the winds well established at SE. If the wind hauls more ahead, and it is thought that a higher rate of speed may be attained by heading a half a point farther to the northward, it should be done without the least hesitation, and a NE. by E. course may be made without the least fear of being thrown too far to leeward. By working in this way the parallel of 5° S. may be reached between 1° and 6° W.;* and, after this parallel shall have been passed the winds will haul fair, and become steady between SSE. and SW., where they will remain up to the Gaboon, which will be reached without experiencing any calms at all, and with the winds always fair, this season being very favorable for this passage.

In *October*, *November*, and *December*, after crossing 20° S. in the vicinity of 28° 10′ W., there will be about 40 per cent. of SE. and E. winds,

* We make this limit very large, because of the different qualities of different vessels. Some may reach it at 1° or 0° W.; while others, preferring to keep a good rap full, or even with studding-sails set, may cross it at 5° W., or even 6° W., and may, we believe, make a very quick passage.

with which vessels should brace sharp up on the starboard tack; and about 20 per cent. of chances of NE. winds, with which the port tack should be taken, provided vessels are to the northward of 18° N. when they are felt, otherwise the starboard tacks should be kept aboard until that parallel is reached. In this manner the meridian of 30° W. may be crossed between 16° and 18° S.

After passing 30° W., the winds being constantly from SE. and E., will permit 15° S. to be crossed somewhere between 20° 10′ and 21° 40′ W. From this time trade-winds blowing regularly and persistently from SE. may be relied on, and with them 10° S. may be crossed between 7° 30′ and 10° W. Sometimes vessels may be forced, by carrying too good a full, to cross 10° S. at 11° or 11° 30′ W., but this will not be of any consequence provided an increased rate of speed has been maintained.

In all cases, after having reached to the northward of 10° S., and to the eastward of 10° W., winds varying from SSE. to SW. may be relied on. With these winds, and no matter at what meridian the parallel of 10° S. may have been crossed, the course should be laid to cross 6° 30′ S. at 2° 20′ E., and 5° S. at 5° E. From this point, with the winds varying from S. to SW. and W., the course should be laid to cross the equator near the meridian of 6° E., and then the voyage may be ended with ease, and without experiencing any calms. The *détour* which we advise will avoid the zone between 0° and 5° S., and from the meridian of Greenwich to 5° E., in which the chances are in favor of 9 per cent. of calms, which might retain a sailing vessel two or three days, or force an auxiliary steamer to get up steam for one day.

Route from the Gaboon to Rio de Janeiro.—This route, like that from the Gaboon to Bahia, set forth on p. 200, is exceedingly simple. We would refer the reader to that section for the necessary instructions in regard to the first part of it, and will content ourselves with giving, for each season of the year, the points of crossing, and the advice requisite for the latter part.

In *January*, *February*, and *March*, after having crossed the meridian of 10° W. at some place between 3° and 4° S., vessels should steer, with constant SE. winds, on a SW. by W. course, carrying the upper studding-sail, so as to cross successively the meridians 30° W. at 16° 30′ S. and 40° W. at 22° 30′ or 23° S. From this latter point to Rio there will be 13 per cent. of calms, with the winds predominating from E., NE., and N.

In *April*, *May*, and *June*, the meridian of 10° W. will generally be crossed somewhere between 4° and 5° S. From this point to that of 30° W., crossed at 21° S., the winds will be well established from SE., but varying sometimes to E. and NE.

Between 30° and 40° W., which latter should be crossed between 23° and 24° S., the winds will first be variable from S. to NE., and then from SW. to N., passing through E., and blowing oftener from SW. than

from SE. in proportion as the coast is approached. To the westward of 40° W. there will be 13 per cent. of calms and winds varying from SW. to SE., E., NE., or even to NW.

In *July*, *August*, and *September*, after having crossed the meridian of 10° W., somewhere between 3° 30′ and 4° S., vessels should steer direct, with the trades well established at SE., to cross the meridian of 30° W. at 16° 30′ S. Then the winds will vary from E. and NE., hauling more to the NE. the nearer vessels reach the coast of America. The meridian of 40 W. should be crossed between 22° 30′ and 23° S., and the route may easily be continued, as the winds will predominate from E. and NE., and especially from NE., with only 8 or 9 per cent. of calms, which, in comparison with the preceding seasons, is a very small percentage.

In *October*, *November*, and *December:* At this season when vessels find themselves below the line, and to the westward of 5° W., they will have constant southerly winds, and with them studding-sails may be carried, heading W. by S., or even W., without exciting any apprehensions in regard to making southing.

After reaching the meridian of 10° W. the wind will commence to haul fair, *i. e.*, to the SE., allowing vessels to come to port, and head a course for the following points of crossing: 15° S. at 30° W., 19° S. at 36° W., and 23° S. at 41° or 41° 30′ W.

By following this course, after passing 25° W. the winds will often vary to E., and then when past the meridian of 30° W. they will predominate from ESE. to ENE.; and, finally, they will vary from E. to N., predominating from NE., from the meridian of 33° W. to Rio. After reaching to the westward of the meridian of 40° W., 10 per cent. of chances of calms, with winds predominating from NE., but varying from SW. to S., SE., and E., may be counted on.

Route from the line to Montevideo.—This route may easily be deduced from the various indications already given in the numerous preceding sections; and to avoid tautology, we shall here limit ourselves to citing the passages to be consulted.

In the first place reference may be made to route France to the Equator, p. 71, and route New York to the Equator, p. 86, of the *instructions for navigating the North Atlantic Ocean*, where when describing the routes from Europe and the United States to the line, we gave the necessary instructions for working past Cape Saint Roque. Then in route Line to Bahia, p. 186, route Bahia to Cape Horn, p. 190, and route Line to Rio, p. 202, of the present instructions for the South Atlantic, will be found our advice as to getting from the line to Bahia, from Bahia to Rio, and from the line to Rio. Finally, on p. 141 will be found our instructions for standing down the coast when bound from the line to the Pacific Ocean.

The whole of these discussions, taken together, enables us to form a very correct estimate of the various circumstances which, during the

different seasons, will probably attend the voyage from the line to Montevideo. Further, route Rio to Cape Horn, p. 206, there will be found some general instructions as to making the land at the mouth of the river Plata; we think, then, that we should at present limit ourselves to simply indicating the best points of crossing to be followed, by means of which the whole route may be traced on the chart. This route, by the way, is the most favorable, not only for sailing vessels, but also for those auxiliary-steam vessels which desire to save coal by making the most of their voyage under sail.

From the equator to 25°, or even 30° S., this route is about the same as that for vessels bound to the Pacific Ocean (see route Line to the Pacific, p. 141). From 25° or 30° S. to Montevideo, vessels should steer as follows:

In *January*, *February*, and *March*, cross 30° S. between 44° and 44° 30′ W. From this point to the meridian of 50° W., the winds will predominate from the eastward, and will vary from SW. to S., SE., E., NE., and N. The chances are then generally favorable, and a course may easily be run which will cross 34° S. at 50° W. However, as a series of SW. or S. winds may be encountered, we recommend in that case the following rule of action in regard to which tack should be taken: "*Keep between these two lines on the chart:*" 1st, joining 30° S. at 45° W., and 33° S. at 50° W.; 2d, that joining 30° S. at 43° W., and 35° S. at 50° W.

After having crossed 34° S. in the vicinity of 50° W., the winds will blow 30 per cent. of the time from NE., and the rest of the time will be variable from S. to SE., E., and N., with 13 per cent. of calms. The winds often haul to the eastward at the mouth of the river, (see Prevailing Winds, &c., p. 111, and route Rio to Cape Horn, p. 206).

In *April*, *May*, and *June*, the parallel of 25° S. should be crossed at about 39° W. After that will be found some 11 per cent. of calms, with winds predominating from SE. to N., through E., and with them vessels may steer for 30° S. and 45° W. This meridian of 45° W. should never be passed before crossing 30° S., because to the westward of it lies a zone of 23 per cent. of calms. From 30° S., crossed at 45° W., the winds will predominate from NE. to NW., with only 7 per cent. of calms, so that a course may be made to cross 34° S. at 50° W., and then 34° 30′ S. in the vicinity of 52° W. To the westward of the meridian of 50° W. at least 15 per cent. of calms may be counted on, as also winds predominating from N. to NW. Off the mouth of the river, at this season, there will almost always be W. or SW. winds, and at times a S. wind, accompanied by squalls, which often makes it difficult to sight the land or to enter the river. (See Prevailing Winds, &c., p. 111, and Route Rio to Cape Horn, p. 206.)

In *July*, *August*, and *September* the parallel of 25° S. should be crossed at 40° W. and that of 29° S. at 45° W. The winds will generally be very favorable for this, as they blow from SE. to NE., with only 8 per cent.

of calms. The chances of winds will be the same, although those of calms will be greater when between 29° and 30° S. This last parallel should be crossed at about 46° 24′ W. From this point the winds will still be favorable, predominating from NE., N., and NW., with about 8 per cent. of calms. This will be the case as far as the meridian of 50° W., which should be crossed in the vicinity of 33° S. However, during this portion of the route at least 20 per cent. of SW. winds may be counted on. After passing to the westward of this meridian of 50° W. vessels will be exposed to 25 per cent. of SW. winds, and on that account may sometimes be delayed.

Pamperos, or SW. gales, and *suestadas*, or SE. gales (see Prevailing Winds, &c., p. 111), fogs and bad weather generally are to be expected in this season, and particularly when near the land.

In *October*, *November*, and *December* the following crossings should be made: 25° S. in the vicinity of 39° W.; 29° S. at 46° W.; 33° S. at 50° W., and 34° S. at 52° 25′ W.

Following this route there will be, between 25° and 30° S., winds predominating from SE. to NE., with 5 per cent. of calms; from 30° to 33° S., winds predominating from NE. to N.; and, finally, after passing 50° W., the winds will blow principally from NE., with about 11 per cent. of calms. When nearing the land, the winds will be from NNW. at night and from E. to SE. by day.

Routes from Montevideo to Rio, Bahia, and the line.—(1) *From Montevideo to Rio:* Starting from Montevideo in *January*, *February*, or *March*, the winds will predominate from NE. to N., NW., W., and SW., without calms. The course should be laid to cross 35° 30′ S. at 54° W., and to reach 36° S. at 50° W. Beyond this meridian the winds will blow mostly from NE. to N., NW., W., and SW., thereby permitting vessels to run to cross 35° 45′ S. at 45° W. The course should always be toward the east on this parallel of 35° 45′ S. when favorable winds are experienced until the meridian of 42° 30′ is reached, after passing which the course may begin to curve to the northward to cross 35° S. at 40° 10′ W.

Arrived at this point, the course should be as near true north as possible, as the winds will predominate from NE. to N., but will be variable from SE. to NE., N., and NW. When the wind is fair, advantage should be taken of it to steer north between the meridians of 40° and 41° W. If the winds are obliquely across the course, the most favorable tack should be taken, but vessels should keep as much as possible between the meridians of 38° and 42° W.

In this way the parallel of 30° S., which should be crossed in the vicinity of 40° 10′ W., may be reached. From here to the parallel of 25° S., crossed at about 43° W., there will be 7 per cent. of calms, with winds predominating from E. to N. Beyond this the same winds will continue to be encountered, but not so steady, and between that and Rio 13 per cent. of calms may be counted upon. We do not think it

necessary to make any other remark about that part of the passage between 30° S. and Rio than that a true north course should be made, even with fair winds from SW., S., SE., and E. In this way vessels will remain as long as possible to the eastward, that is, to windward of Rio; and consequently, if circumstances are favorable, will cross 25° S. at 42° W., and 24° S. at 42° 30′ W. In case of head winds, or if the wind hauls to NE., they may make a good run on the starboard tack, heading NNW.; and may even keep on that tack with the wind at N., provided it does not hang at that point for a long time, and that the vessel is still to the eastward of the meridian of 43° W.

In *April*, *May*, and *June*, upon leaving Montevideo, the predominating winds encountered will be those from N. to NW., W., SW., and S. These will permit vessels to reach 36° or 36° 30′ S. at 54° or 54° 30′ W., and easting should then be made by keeping between the parallels of 36° and 36° 30′ S., as far as the meridian of 47° 30′ W., which should be crossed at 36° S. From that point, the winds being mostly from NW., W., and SW., the course may trend to the northward, so as to cross 35° S. at 44° 25′ W.; 32° 30′ S. at 40° W.; 31° S. at 37° 30′ W.; and 30° S. at 36° W.

From the latter position the winds will be found to vary exceedingly, blowing from all points of the compass successively, although predominating perhaps from N. Consequently if, after having crossed the parallel of 30° S., the winds will permit, a NE. by N. course should be steered, so as to cross 28° S., and even 27° S., if it is possible, in the vicinity of 36° W. The precaution of getting well to the eastward should be taken if the winds are seen to haul to the southward or to the eastward of S., for after reaching SE. they may be expected very soon to change to NE. and N., and with them a NNW. and then WNW. course may be made. As a general thing, an effort should be made to cross 26° S. at 38° W. and 24° S. at 40° W.

We will add that, when approaching the parallels of 26° and 25° S., the winds will be found more favorable and blowing but rarely from the northward. To the northward of the latter parallel the prevailing winds will be those from S. to SE. and NE. It is also useful to note that the winds will be better established in proportion to the distance to the eastward; while, on the other hand, they will be the more unsteady the nearer we reach 40° W., and there are 12 or 13 per cent. of calms to be expected in the space comprised between that meridian, the thirtieth parallel, and the harbor of Rio.

In *July*, *August*, and *September:* This is the season of *pamperos* and bad weather generally. (See Prevailing Winds, &c., p. 111.) Leaving Montevideo, vessels should ordinarily make a course that will cross 35° 15′ S. in the neighborhood of 55° W., and then trend to the eastward, trying to cross 35° S. at about 52° W. During this part of the course vessels may be favored by strong NE. to NW. breezes; but, as a general thing, the predominating winds will be those from S. to SE. and

NE., during the continuance of which one would naturally choose that tack which would give the most easting. At this place, we will advise sailing vessels never to leave the Mount with the wind blowing from S. or SSE., because such winds very soon haul to NE. and N.; but, on the contrary, they should profit by northerly winds, which are always the forerunners of a long series of favorable breezes. This same remark applies to auxiliary steam vessels desiring to use as little coal as possible.

From 35° S. the course should be to cross 34° S. at 50° W.; 33° S. at 48° W.; 31° S. at 45° W., and 30° S. at 43° 20′ W. These are the points of crossings which may be proposed to follow when the winds are favorable; but when they are ahead, the tack which keeps nearest to that course should be taken. Vessels may count on about 8 or 9 per cent. of calms; 14 per cent. of N., 15 per cent. of NW., 21 per cent. of SW., 17 per cent. of SE., and 24 per cent. of NE. winds. From this it may be seen that as there are but 24 per cent. of chances in favor of head winds, and 8 or 9 per cent. of calms, this is a comparatively favorable zone, lying as it does in the midst of others so much worse. So soon as the southerly winds begin to cant to the eastward, we would advise vessels hauling to the eastward of this indicated route, but at the same time taking care not to pass the line, which should be drawn on the chart, joining the following points: 30° S. and 42° 10′ W., and 35° S. and 48° 20° W. By this means vessels will be in a good position to receive the winds when they haul, as they soon will, to E. and NE. The starboard tack may then be prolonged until the line joining the following points is reached: 29° S. at 45° W., and 33° S. at 50° W. These two lines, as it may have been seen, represent the eastern and western limits of the space in which vessels should alway keep.

After having crossed 30° S. in the vicinity of 43° 20′ W., vessels make all possible speed, steering N. on this last meridian. Between that point and Rio the predominating winds will be those from NE.; but the hope of encountering SW., S., or SE. winds may be entertained, and with them all possible easting should be made, as far as 42° or 41° W., if practicable. In this manner vessels will avoid being to leeward in case the wind comes out at NE., and they may make a long board on the starboard tack. It will be best in all cases to avoid getting very near the meridian of 45° W., since to the westward of it the chances are 15 per cent. in favor of calms. The parallel of 25° S. should be crossed at 42° or 42° 40′ W., and from there to Rio the passage is very simple, as the chances of weather are about the same.

Following this route from Montevideo to Rio, there is a mean of 8 per cent. of chances of calms to be met with.

In *October*, *November*, and *December*, sailing vessels and auxiliary steamers which do not desire to steam against NE. winds, should make a good run to the SE. after leaving Montevideo, so as to reach the parallel of 36° S. at or about the meridian of 55° W., in the quickest man-

ner possible. The course should then be to the eastward, running between the parallels of 36° and 36° 30′ S.; and, unless the winds are contrary, which will rarely happen, the parallel of 36° S. should not be crossed again until the meridian of 42° 10′ or 42° 40′ W. shall have been reached; from this latter position the course should be to cross 35° S. at 39° 10′ W. This part of the route is generally made very quickly; this *détour*, although appearing very considerable, is absolutely indispensable to avoid the necessity of beating against the persistent NE. winds which will be found between 35° S. and Rio de Janeiro.

If the precaution of crossing 35° S. at 39° 30′ or 38° 30′ W. (which last is the better point) is taken, vessels may thenceforth steer for Rio according to the direction of the winds. These winds, although, as we said, predominating from NE., will be rather variable. Vessels should endeavor to keep to the eastward of a line passing through Rio in a NNW. and SSE. direction. This line, which may be followed when the winds permit, crosses 30° S. at 40° W., and 25° S. at 42° 25′ W. After having passed the parallel of 25° S., 9 per cent. of calms may be expected; but, during the remainder of the voyage, the winds will be well established. Consequently, auxiliary-steam vessels will not be obliged to get up steam until they are about to make the land near Rio.

Route from Montevideo to Bahia: In *January*, *February*, and *March*, vessels should begin to make easting when between 35° and 36° S., as was directed for vessels bound for Rio. The parallel of 35° S. should be crossed at or about 38° W., and from that time the winds will be found varying from S. to SE., E., NE., N., and NW., but predominating from the last two directions (about 30 per cent. of N. and 30 per cent. of NW. winds) With these winds it will generally be very easy to cross 30° S. somewhere between 40° and 42° W.

Between 30° and 25° S., which last should, if possible, be crossed between 28° and 30° W., there will be 6 per cent. of calms, with winds predominating from SE. to E., NE., N., and NW. The best course through this portion of the route is NNE., true; but we wish it understood that vessels should not hug the wind too close in order to make this course, but should rather keep away ½ point so as to go through the water at a better rate; remembering that the port tack making easting is preferable to the starboard tack making westing.

After having crossed 25° S. in the vicinity of 29° W., the winds will be found blowing from SE. to N., and by their aid vessels may steer direct for Bahia, heading NW. by N., or nearly so, when the winds, as frequently will be the case, are favorable; but when they haul to the northward of NE. and blow from NNE. or N., the starboard tack should be taken, and kept until a favorable change occurs. It will not be necessary to go about unless the wind hauls to the westward of N., which, we may say, never occurs. As northing is made, the winds will be found to haul fair, and no uneasiness need be felt if 22° S. should be

crossed to the eastward of 36° W. and 20° S. to the eastward of 38° W.

From 20° to 17° S. the winds will prevail from SE. to NE. When the wind is at SE. or E. the precaution of steering one point to windward of the course should be taken, so as to be able to keep a good full when the wind comes out at NE. After having crossed 17° S. at or about 37° 30′ W., the winds blowing from SE. will permit the voyage to be finished with great ease.

In *April*, *May*, and *June*, vessels bound to Bahia should, until reaching the parallel of 30° S., follow the same course as was given for vessels bound to Rio de Janeiro.* After having crossed 30° S. at or about 36° W., or a little farther to the eastward, the course should be laid, as the winds, although variable from SW. through E. to N., predominate from the last direction in such a way as to cross 25° S. somewhere between 37° 30′ and 39° W. This may generally be accomplished with ease, provided a true N. or even a N. by E. course is made, when the winds are fair for that purpose, by keeping, if possible, between the meridians of 34° 30′ and 36° 30′ W. When the winds haul to NE. a good NNW. course may be run; and, finally, if a series of N. winds are encountered, which, by the way, often happens, the starboard tack may be taken and kept, heading WNW. so long as the meridian of 41° W. is not passed. With the wind at NW. the port tack must be taken, but this rarely happens.

After having crossed 25° S. in the vicinity of 38° or 38° 30′ W. the winds will be found to predominate from S. to SE. and NE., which, as a general thing, permit 20° S. to be crossed at 38° W. The more northing made the greater the tendency of the winds to haul fair. From the parallel of 20° S. the route may be direct for Bahia (or nearly so) by taking the precaution to head ½ point to the eastward, that is to say, to windward of the port of destination. Beyond 16° or 15° S., the winds will be variable from SE. to NE., but predominating from the eastward. Vessels will be but slightly retarded by calms on this voyage if they will conform to the directions given.

In *July*, *August*, and *September*, this is the season of *pamperos* and bad weather generally. (See Prevailing winds, &c., p. 111). Upon leaving Montevideo the course should be laid to gain, as soon as possible, the parallel of 35° 30′ S., and then to make easting by keeping near that parallel, until the meridian of 50° W. is reached. This portion of the route may generally be made with rather favorable, though variable, winds; in case of head winds the northerly board should not be prolonged beyond 35° S. When near 50° 30′ W. it will be best to make a good deal of southing, so as to reach 36° 30′ S., along which the remaining easting should be made, as the winds will be very favorable from 50° to 41° W. From the latter point the course should trend to the northward, and 35° S. should be crossed at 38° 20′ W.

* On this subject see what was said at the beginning of the present section.

From this point the winds will be found predominating from N. to NW., W., and SW., hauling at times to S. and SE. A line, joining the points 35° S. and 38° 20′ W. and 30° S. and 33° W., may be drawn on the chart, as a reference line, and every effort should be made to make a course corresponding to it, keeping nearer to, or farther from it, according to the direction of the winds.

From 30° S., crossed between 33° and 34° W. to 25° S., the winds will predominate from SE. to E., NE., and N., with which the starboard tack should be taken. The vessel should be kept at a good full, even with northerly winds, and no difficulty will be experienced in crossing 25° S. somewhere between 35° and 37° W.

Between 25° S. and Bahia the winds will be variable from SE. to NE., and will haul to the SE. in proportion as northing is made.

In *October*, *November*, and *December*, when leaving Montevideo, an easterly course should be taken, as was pointed out in the present section for vessels bound to Rio. The parallel of 35° S. should be crossed at 38° 30′ W., and then successively 30° S. at 33° 30′ W.; 25° S. at the same meridian of 33° 30′ W.; 20° S. at 35° W., and 15° S. at 36° 20′ W.

From 35° to 30° S. the winds will be exceedingly variable, and by their aid the route indicated may generally be followed, or at least very nearly approached. The starboard tack should be taken when the wind blows from ESE. to NNE., and when the wind hauls to N. (and à *fortiori* to NW.) the port tack must be taken; finally, advantage must be taken of all fair winds, from NW. to SE., through S., to make all the easting possible. In this manner 30° S. may be crossed in the vicinity of 33° 30′ W. The farther to the eastward that parallel is crossed the better will it be.

Between 30° and 25° S. as much as possible of a true N. course should be made. The prevailing winds will be those from SE. to E. and NE., and with them the starboard tack should be taken. We would advise making a NNE. course when the winds are from SE. to E., so as to be able to take the starboard tack when they haul to NE. or N. The parallel of 25° S. should never be crossed, if it can possibly be avoided, to the westward of 34° 30′ W.

From the parallel of 25 S. to Bahia, the winds will vary from SE. to E., and NNE. It will be preferable then, until Bahia is brought to bear NW., to profit by every series of SE. and easterly winds, in order to steer N. or N. by E. By taking this precaution, vessels may carry a good rap full if the winds haul to NE. and NNE. Finally, a direct course for Bahia may be steered when this port bears NW. or NW. by N. true.

From Montevideo to the line. In *January*, *February*, and *March:* Vessels bound to Europe, the United States, or the West Indies, should follow, as far as 25° S., the same course as was given for vessels bound to Bahia. They will cross, successively, 35° S. at 38° W.; 30° S. at 30°

W., and 25° S. at 29°, or oftener 28° W. In the first two parts of this section may be found the necessary remarks on the commencement of this passage.

From 25° to 20° S. (crossed at 26° W.) the winds will vary from SE. to E., NE., and N. With the winds from SE. to NE. the starboard tack should be taken, and vessels should go about so soon as the wind hauls to NNE. and N.

After having passed 20° S. at 26° W. the trades will be found blowing ordinarily from SE. to E., and with them a good run may be made on the starboard tack. These trades sometimes haul to NE. and N. In case a vessel has the bad luck to fall in with NE. or northerly winds the port tack must be retaken, but luckily that breeze seldom lasts for any length of time. However, the trades are never certain and well established from SE. to E., until after 15° S. is passed, and that should be done in the vicinity of 25° W.

Vessels *bound to Europe* should run to cross the line, in January, at 24° 30′ W.; in February, at 24° W., and in March, at 24° 30′ W. Those *bound to the United States* should generally cross 15° S. at 26° 30′ W., and the equator at 30° W. Vessels *bound to the West Indies* should also cross the parallel of 15° S. at 26° 30′ W.; then, with fair winds, they should steer to reach 10° S. at 30° W., and the line somewhere between 35° and 36° W.

In *April*, *May*, and *June*, upon leaving Montevideo, the prevailing winds will be found to be those from N., through W. to S. They will permit 36° or 36° 30′ to be reached at 54° 30′ or 54° W.; then the easting should be run down between these parallels until 47° 30′ W., which should be crossed at 36° S., is reached. From there the course should trend to the northward, being favored by NW., W., and SW. winds, so as to cross 35° S. at 42° 30′ W., and 30° S. at 43° 30′ W.

Beyond 30° S. the prevailing winds will be those from SE. to N., through E. The starboard tack should be kept so long as the winds are from SE. to NE., nor need the tack be changed unless they haul to NNE. or N. An effort should be made to run to cross 25° S. somewhere between 29° 30′ and 31° W., and beyond that point the winds predominating from SE. to E. will permit 20° S. to be crossed at 27° 30′ W. From this latter point the course should be directly for the point at which it is proposed to cross the line.

Between 20° and 15° S., the trades will be variable from SE. to E., blowing at times from NE. From 15° to 10° S. they will predominate from SE., hauling, exceptionally, to E. Finally, to the northward of 10° S. they will be directly from SE.

Vessels *bound to Europe* should cross 10° S. at 26° W., and the equator, in April and May, at 24° W., and in June at 23° 30′ W. Those *bound to the United States*, in this season, should cross 10° S. at 29° 15′ W., and the equator at 31° 10′ W. Those *bound to the West Indies*

should cross 20° S. in the vicinity of 29° W.; they should then steer, with fair winds, to reach 10° S, at 33° 30′ W., and the equator in the neighborhood of 35° W.

In *July*, *August*, and *September*, this being the season of *pamperos*, and bad weather generally, upon leaving Montevideo, vessels should steer so as to reach the parallel of 35° 30′ S. in the quickest manner possible. They should then make to the eastward, keeping on this parallel, until the meridian of 50° 10′ is reached. This portion of the route will be made with rather favorable, although variable winds. In case of having to beat against head-winds, the northerly tack should not be prolonged to the northward of 35° S. When nearing the meridian of 50° W. it will be very advantageous to put all the southing possible in the course, so as to reach 36° 30′ S., on which it is best to run down the remaining longitude, as the winds are exceedingly favorable, on that parallel, between 50° and 40° W. From this latter point the course should begin to turn so as to cross 35° S. somewhere between 36° 10′ and 35° 40′ W.

Between the parallel of 35° S. and that of 30° S., which latter should be crossed at 27° 30′ W., the prevailing winds will be those from N. to NW., or favorable for the indicated route. For instructions as to the latter part of this route, we refer the reader to what has been said in Route From the Pacific to the Line, p. 152, as, at this season, the route of vessels from Montevideo to the line is the same after leaving 35° or 30° S., as that for vessels sailing from the Horn direct to the line.

They should cross 25° S. in the vicinity of 24° W., and 23° S. between 23° and 24° W., from which point the SE. trades may be counted on as being well established from SE. to E. These winds will permit vessels to run directly for the point at which they propose to cross the equator.

Vessels *bound to Europe* should cross the line somewhere between 21° 30′ and 22° 30′ W., and the parallel of 5° N. in the vicinity of 22° W. Between the line and 5° N. the winds will be from S. to SE., without calms.

Vessels *bound to the United States* should, as a general thing, cross the parallel of 25° S. in the vicinity of 25° 30′ W.; that is to say, a little farther to the westward than do those which are bound to Europe. From the above point they should steer, the wind being constantly fair, to cross 5° N. at 27° 30′ W. Between 25° and 20° S. the winds will be from SE. to E., and at times, though rarely, they may blow from NE., and with these latter a NNW. course may be made. After having crossed 20° S. at 25° 20′ W., the trades will be variable from SE. to E., as far as the parallel of 15° S. From 15° to 10° S. they will be steady from SE. From 10° S. crossed at 26° 10′ W., to the equator, crossed at 27° W., the winds will predominate from SE., but may vary to S. Finally, from the line to 5° N. they will predominate from S., but may vary to SE., without calms.

Vessels *bound to the West Indies*, like those bound to the United States, should cross 25° S. in the vicinity of 25° 10′ W. From this point they should steer, the winds being constantly in their favor (from SE. to ESE.), to cross, successively, 20° S. at 27° 15′ W.; 10° S. at 32° W.; 5° S. at 34° W., and the equator at 37° 30′ W.

In *October*, *November*, and *December*, when leaving Montevideo, the course should be to the SE., so as to reach in the shortest time possible the parallel of 36° S. in the vicinity of 55° W. It should then be due E., between 36° and 36° 30′ S., and unless forced by head-winds (which will be very rare), 36° S. should not be recrossed before the meridian of 31°, or even 30° W., shall have been reached; and from this point the course should be to cross 35° S. at 27° 30′ W.

During that part of the route between Montevideo and the meridian of 50° W. the dominant winds will be those from S. to SE. and NE.; beyond this meridian they will generally be from NW. to SW.

After having crossed 35° S., the winds will be variable from SW. to SE., E., and N. These latter winds will be frequent, and when encountered the port tack should be taken, coming up to the course as the wind hauls to NNW. and NW. In this way, without much difficulty, 30° S. may be crossed at 22° 30′ W.

Between 30° and 25° S., vessels will be very much bothered by the winds which will predominate from NE. and N.; with the first (which are more frequent) the starboard tack should be taken; and with the second the port tack. The essential thing to be done is to cross 25° S. between 20° and 25° W., and to keep between these two extreme limits (but as near as possible to 22° 30′ W.), until the parallel of 20° S. shall be reached. Between 25° and 20° S. the winds will generally be favorable, varying from SE. to NE., and predominating from E., which will permit 20° S. to be crossed in the vicinity of 22° 30′ W., which is the most favorable point. Beyond the parallel of 20° S. lies the region of well-established trades, with which, as the winds are always fair, the course may be as follows:

For vessels *bound to Europe*, to cross the equator, in October and November, between 22° and 24° W.; and in December between 23° and 25° W. For vessels *bound to the United States*, to cross the line at 30° W.

Vessels *bound to the West Indies* should made a direct course to pass about 50 miles off shore of Cape Saint Roque and to cross the equator near 37° 30′ or 38° W.

Route from Montevideo to Cape Horn.—Between the parallel of 40° South and the Horn, the course for vessels out of Montevideo is the same as for those coming from the equator; the points of crossing and the necessary instructions will be found in Route Line to the Pacific Ocean, p. 141, and we shall only occupy ourselves at present with that portion of the route lying between Montevideo and the parallel of 40° S.

In *January*, *February*, and *March*, from Montevideo, the course should be, with variable winds,* to cross 37° S. in the vicinity of 56° W. From there it should be, profiting by the prevailing NW. winds, to cross 40° S. at 58° W. The route should then continue as was pointed out in Route Line to the Pacific Ocean, p. 141, remembering that it is best to cross 40° S. as far as possible to the westward, that is, to windward.

In *April*, *May*, and *June*, leaving Montevideo, the winds being generally favorable, that is, from N. and NW., will permit 38° S. to be crossed at 56° W. Then winds from NW. to SW. and S. may be counted on. With those from NW. the coast should be approached as close as possible, so as to be in the best position for receiving a SW. wind, as in that case it would be necessary to make a SSE. course. To sum up, every effort should be made to cross 40° S. as far to the westward as possible, which will be in the vicinity of 57° or 58° W. The rest of the route should be according to the instructions of Route Line to the Pacific Ocean, p. 141.

In *July*, *August*, and *September*: At this season a series of winds may be expected, which being well established at east, gradually haul to NE. and N., and permit a good run being made to cross 36 S. at 55° 30′ W., and 37° S. at 54° 50′ W. A bright lookout should be kept for bad weather, *pamperos*, &c. Between 35° and 40° S., the prevailing winds will be those from SE., but they may vary from SW. to SE., NE., and NW. The course should generally be to cross 40° S. in the vicinity of 57° 30′ W.

In *October*, *November*, and *December*, the course should be as follows: to cross 35° 45′ S. at 55° W.; 37° S. at 54° 15′ W.; 38° 30′ S. at the same meridian of 54° 15′ W.; 40 S. at 56° 10′ W.; 43° S. at 60° W., and so on.

Leaving Montevideo with a series of winds from NE., turning to N. and NW., it will be easy to cross 36° S. to the eastward of the meridian of 55° W. From this parallel to that of 38° 30′ S., the course should be due south, as the winds will be variable, but rather predominating from NE. through N., W., and S. to SE.

In case of head winds, the port-tack board should not be prolonged by sailing vessels to the westward of the meridian of 55° W., until after the parallel of 39° S. shall have been reached. If this precaution is neglected, vessels will fall into a zone containing some 16 or 17 per cent. of calms. From 38° or 38° 30′ S., westing may be put into the course, which should then trend to reach 40° S. in the vicinity of 56° 10′ W. Beyond this, the instructions given in Route Line to the Pacific Ocean, p. 141, should be followed.

From Cape Horn to Montevideo.—Vessels returning from the Pacific and bound to Montevideo, may choose either of three ways:

* Useful information in regard to winds, weather, &c., in these localities, may be found, for each season of the year, in Southeast Trade Winds, p. 103, and Prevailing Winds, &c., p. 111.

to take the Straits of Le Maire; double Staten Island and pass to the westward of the Falklands; or, finally, to pass outside (to the eastward) of the Falkland group.

The passage by way of the Straits of Le Maire should not be attempted by *sailing vessels*, unless they have a well-established free wind, for instance, winds from the westward, hauling to SW. In fine weather auxiliary steam vessels will be very much benefited by taking to this passage, in which the current is favorable, and which at its end places vessels in a longitude well to the westward, and consequently in a good position from which to run, with the winds from NW. to SW., for their port of destination.

If it is decided not to try the passage by way of the Straits of Le Maire, the next best one is by passing outside of Staten Island, and then inshore of the Falkland group. This route is always easy to follow, and by it a very good passage may be made, although not so fine as by way of the Straits of Le Maire. We may remark here that the advantages of the route to the westward of the Falklands, lie in a much lighter sea, fairer winds, and a favorable current. But these considerations, which are important in the case of vessels bound to Montevideo, need not be taken into account in the case of vessels sailing direct from the Horn to the line, or even to Rio or Bahia. In that case, as we have already said in Route Pacific to the Line, p. 152, Route Cape Horn, &c., to Bahia, p. 191, and Route Cape Horn, &c., to Rio, p. 211, the best route, that is, the shortest, is the outside one, leading to the eastward of the Falklands.

Finally, in case vessels are forced to take the passage to the eastward of the Falklands, when bound to Montevideo, the passage will be made under circumstances a little less favorable, but at the same time without any serious difficulty to be overcome.

We shall proceed to indicate the principal points of crossings in the routes for each season of the year; these will be arranged for the passage by way of the Straits of Magellan, and inshore or off shore of the Falkland group.

In *January*, *February*, and *March*, vessels leaving *Cape Virgins*, after having passed through the Straits of Magellan, will find the winds variable, but predominating from the southward and westward; with these they may run to cross 50° S. at 65° W., and 45° S. at 62° 10′ W. The winds will then predominate from SSW., and 40° S. may easily be crossed at 59° 10′ W. From this latter parallel the winds will blow rather frequently from NW., and 38° S. may be crossed at 56° 10′ W. After this the winds will predominate from the northward and eastward as far as the mouth of the river, and this passage may easily be finished.

Vessels coming from *the Straits of Le Maire*, and those passing to the *eastward of Staten Island*, may easily pass *inshore* of the Falklands. with winds rather variable, but predominating from WSW. They should then steer to cross 52° S. at 65° 10′ W.; 50° S. at 64° W.; 45°

S. at 62° 30′ W., and end their voyage the same as though they had come by way of the Straits of Magellan.

Vessels having doubled Cape Horn, and decided to pass off shore of the Falklands, should cross the parallel of 50° S. at 50° W., and beyond this parallel they will find the winds variable from the NNW. to SW., but predominating from NW. The following is the general rule of conduct in such cases: Make a true N., or even a N. by E. course, when the winds permit, and then steer close-hauled on the port tack when the wind comes out to the northward of WNW. By steering in this way, 45° S. may be crossed somewhere between 53° and 54° W., whence the same course may be continued, the winds to be encountered being nearly the same. We should say that there is but one difference to be noted, and that is there are a very few chances in favor of NNE. winds, and with them the starboard tack should be taken. As a general thing 40° S. may be crossed somewhere between 53° 30′ and 54° 30′ W. To the northward of 40° S., the two series of prevalent winds will be, first, those from NE. to N., and afterward those from W. to SW. By laying the course with reference to the wind actually blowing, as well as with regard to that which may be expected, the passage may easily be finished.

In *April*, *May*, and *June*, vessels coming from the *Straits of Magellan* will find the wind exceedingly variable, but predominating from a WSW. direction, and with them they should endeavor to cross 51° S. at 67° 10′ W.; 50° S. at 66° 10′ W.; 48° S. at 65° W., and 45° S. at 64° W. The winds will then be found to predominate from NW., although still very variable, and 40° S. should, if possible, be crossed in the vicinity of 59° W., and 37° S. and 56° W.

Vessels coming from the *Straits of Le Maire* will first experience winds from NW. to SW.; and with them they should steer to N. by W. true, whenever it is possible to do so, so as to be able to cross 52° 30′ S. as near as possible to 65° 10′ W. Between the parallels of 52° 30′ and 50° S. the winds will predominate from NNW. to WNW., when to the eastward of the meridian of 65° W.; while to the westward of this meridian they will predominate from NE. to N. between 52° and 51° S.; and from SW. to SE. when between 51° and 50° S. The course should be laid to cross 50° S. in the neighborhood of 65° W.; beyond this the winds will be found to predominate from WNW. to WSW., accompanied by 9 per cent. of calms. It will be easy then to cross 45° S. at 64° W., and to finish the voyage as was directed for vessels coming from the Straits of Magellan.

Those vessels which after doubling Cape Horn do not take the Straits of Le Maire will find themselves in a very bad position if they desire to pass to the westward of the Falklands, and should, at this season, rather prefer to pass off shore of that group. Nevertheless, if it is decided to try the inshore passage, care must be taken in regard to winds from NNW. to WNW., as these winds prevail in the space between 54°

and 50° S., and the meridians of 60° and 65° W. After having passed 50° S., the winds will frequently be found from WNW. to WSW., which will permit a course being made to cross 45° S. in the vicinity of 63° 30′ W. The voyage should end exactly the same as though the vessel had come by way of the Straits of Magellan.

As a general thing, however, *if vessels do not take the Straits of Le Maire* when coming from Cape Horn, during the months of April, May, and June, they should prefer to pass close outside of the Falkland group. For this purpose the most westing possible should be put into the course after leaving 51° S., and 50° S. should, if possible, be crossed somewhere between 57° and 58° W. Between 50° and 40° S., the winds will vary from NW. to WSW., and the course should be laid to cross 45° S. somewhere between 57° 30′ and 60° 30′ W., but nearer, if possible, to the latter. After having crossed 45° S., the winds will be exceedingly variable, but blowing rather oftener from NNW. than from any other direction. The course should be, according to circumstances, to cross 40° S. between 57° 30′ and 58° W.; after which the winds will be from NW. to SW., and with them 37° S. may be crossed at some place between 55° 30′ and 56° W.

In *July*, *August*, and *September*, vessels coming from the Straits of Magellan will have every facility for running to Montevideo under sail. Leaving Cape Virgins the winds will first predominate from the westward, but blowing rather often from the points between NNE. and NW., which, of course, will be contrary. Nevertheless, there need be no source of anxiety, so long as the parallel of 50° S. is *not* crossed to the eastward of 62° 30′ W.

Between the parallels of 50° and 45° S. the winds will blow from NNE. to NW. and SW., and the port tacks should be kept aboard until the vessel heads to the westward of N. Of course, with a fair wind from W. or SW., the course should be N., or even N. by W., if the vessel happens to be rather far to leeward; but it will suffice, in all cases, to cross 45° S. at 58° or even 57° 30′ W.

Between the parallels of 45° and 40° S. there will be 70 per cent. of chances of very favorable winds (SW.) and about 30 per cent. of chances of NNW. winds. A north, or even a little west of north, course should always be made, if by so doing a spread of canvas favorable to great speed can be carried. Although the NNW. wind blows most rarely, still it is always well to bear in mind that there are thirty chances in its favor, and that with it the port tack, heading NE., must be taken. The best point at which 40° S. can be crossed is in the vicinity of 56° W.

Between 40° S. and Montevideo the winds will predominate from SE., but will generally vary from SW. to SE. and NE. All these directions will be favorable, if our advice of crossing 40° S. at 56° W. is only followed. We shall call to mind that *pamperos* and *suestadas*, and especially the latter, are very much to be feared at this season of the

year. The SE. gales are very bad, as the whole coast is then covered with a haze or fog, making it difficult, if not impossible, to run in for a land fall.*

As a general thing, between Cape Horn and Staten Island the winds are from WNW. to W., and SW.; prevailing from WSW. With these winds an effort should be made to pass through the Le Maire Straits, but in case that should, for any reason, be imprudent, the route would then lead around the outside of Staten Island, and then northward, on a N. by W. course, to pass inshore of the Falklands. From Staten Island to 50° S. the prevailing winds will be those from WNW. They will, however, vary from NNE. to NW. and WSW., and there is no other rule to be followed than to make all possible northing, even putting a little westing in the route when the winds permit. Vessels will not be in a bad position if they cross 51° S. to the westward of 62° 30′ W., and 50° S. to the westward of 62°, or even 61° 30′ W.

The advantage to be gained by passing through the Straits of Le Maire is too evident to require comment, since by doing so vessels are in a position some 60 miles to windward of where they would be were they to go around Staten Island. After reaching 50° S. in the vicinity of 62° W., the voyage may be terminated as was directed for vessels coming by way of the Straits of Magellan.

Finally, in case Cape Horn proper has been doubled, and vessels either cannot or do not wish to pass to the westward of the Falklands, they will be in a very *unfavorable position* from which to reach Montevideo under sail. The winds will, first, that is just to the eastward of the Falklands, be from NNE. to SW., and very frequently from NNW. to WNW., and with them it will be very difficult to reach 50° S. to the westward of 56° W. Between 50° and 45° S. the winds will predominate from NW., and with them it will be very hard to reach 45° S. at 54° W. From 45° to 40° S, there will be the following chances of weather: 25 per cent. of SSE. or very favorable winds; 25 per cent. of NNW., or head winds, and the other 50 per cent. will be winds from WNW. to WSW. Under these circumstances the only advice that can be given is to make all the northing possible so as to reach 45° S. in the shortest time possible. Beyond this the winds will predominate from S. to SE. and NE., and consequently, as a general thing, be favorable.

To sum up, we shall say that it is almost a necessity, at this season of the year, for vessels *coming around Cape Horn to try for* the passage by way of the *Straits of Le Maire*, or at least to the westward of the Falklands.

In *October*, *November*, and *December*, vessels starting from the *Straits of Magellan* will at first find the winds exceedingly variable, although almost always favorable. This will last until the parallel of 50° S., which should be crossed at 55° W., is reached. From 50° to 45° S. the

* See what was said on this subject in Prevailing Winds, &c., p. 111.

winds will predominate from NW. to SW., which will permit 45° S. to be reached in the vicinity of 59° 30′ W. From 45° to 40° S., there will be the same chances of winds predominating from NW. to SW., and heading ships off perhaps to N. or N. by E., with which 40° S. may be crossed at or about 53° 30′ W. Beyond 40° S. the winds will blow 25 per cent. of the time from NE.; 30 per cent. from N. and NW.; and with the same percentage of S. and SE. winds, and the rest of the time from SW. With such probabilities it will be best to steer, while the winds are fair, so as to cross as nearly as possible 38° S. at 53° 30′ W., and 3 .° S. at 54° W.

Vessels having doubled Cape Horn should endeavor to go through the Straits of Le Maire. However, the prevailing winds at this season, between Cape Horn and Staten Island, being those from NNE. to NNW., it will often be impossible to follow that route. In that case every effort should be made to cross the parallel of Staten Island (54° 40′ S.) at or a little to the westward of 63° W.; then to steer due N., or even N. by W., with the winds which will be found from WNW. to WSW. In this way those vessels which may have passed through the Straits of Le Maire, or to the eastward of Staten Island, may expect to cross 52° S. at 64° 30′, or 64° W.; the first will evidently have the advantage over the second; they will have the winds more quartering, and may arrive sooner at the indicated point of crossing. From 52° to 40° S. the winds will blow from NNE. to NNW., WNW., and WSW., and will generally permit 50° S. to be crossed with ease at 62° 30′ W.; 45° S. at 57° W., and 40° S. at 53° 30′ W. The voyage ends the same as with vessels from the Straits of Magellan, which also reach 40° S. at 53° 30′ W.

Vessels which, having doubled Cape Horn, are unable either to go through the Straits of Le Maire, or to cross 54° 40′ S. to the westward of the meridian of 63° W., must content themselves with passing *to the eastward of the Falklands*. They may easily, with the winds which will be from WNW. to WSW., run to cross 50° S. in the vicinity of 56° 30′ W. Between 50° and 40° S. they will find the winds generally prevailing from NNW. to WSW., with which we advise a due N. course to be steered whenever it is possible, and to steer close-hauled on the port tack when the wind comes out at WNW. Finally, with the wind at E. and N., we advise the starboard tack to be taken. In this way 45° S. may be crossed in the vicinity of 54° W., and 40° S. at 53° W. From the latter point the course may be laid for Montevideo, as has already been pointed out.

Route from Montevideo to the Cape of Good Hope.—This matter is so very simple that we shall only speak of it for the purpose of mentioning it in these instructions.

Leaving Montevideo, vessels bound to the cape will endeavor to reach the parallel of 37° S. somewhere in the vicinity of 50° W., and should then run down their easting between the parallels of 37° and 38° S.,

with almost constant westerly winds. The passage will end as pointed out in Route Line to Cape of Good Hope, p. 137.

Vessels bound to the Indian Ocean, the Straits of Sunda, or the Pacific, should first run to reach 37° S. at 50° W., and should then steer, according to the season, to reach the different latitudes, by always trying to keep as much as possible outside of the limit of icebergs. Thus the following points of crossing may be proposed:

In January, February, and March, 38° S. at 40° W., 40° S. at 20° W., and 43° S. at 20° E.

In April, May, and June, 41° S. at 35° W.; 44° S. at 16° 20′ W., and 45° S. at the meridian of Greenwich.

In July, August, and September, 40° S. at 37° 20′ W.; 43° S. at 21° W.; 45° S. at 5° W., and 46° S. at 10° E.

In October, November, and December, 39° S. at 30° W.; 40° S. at 17° W., and 42° 30′ S. at 14° 20′ E.

The last part of the voyage will vary according to the port of destination, and there will be found, in the *instructions for navigating the Indian Ocean*, some remarks upon the choice of the parallel on which to run down the easting, and on the meridian at which it will be best to commence trending to the northward.

Route from the Cape of Good Hope to Montevideo.—Vessels coming from the Indian Ocean, or starting from the Cape of Good Hope, and bound to Montevideo, should at first steer so as to gain the SE. trades. This was fully explained in Route Cape of Good Hope to the Line, p. 139, and Route Remarks Doubling Cape of Good Hope, p. 178. They should then steer to the westward, keeping in a latitude varying from 22° to 27° S., where the winds will be from SE. to E., and very well established. Finally, they should begin to trend to the southward, sooner or later, according to the season, and having exercised care in their choice, so as to be in a good position from which to take the winds which predominate in the western part of the Atlantic Ocean.

The following table will give the best points of crossings for each quarter of the year, and following it will be some remarks upon the chances of weather which may generally be expected on these different routes.

The most favorable season for this passage is from October 1 to January 1; the most unfavorable from April 1 to October 1.

Season in which the passage may be made.	Latitude at which it is preferable to cross the meridian of—									
	15° E.	5° E.	5° W.	15° W.	20° W.	25° W.	30° W.	35° W.	40° W.	50° W.
	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
January, February, and March	32 30	28 00	26 50	26 35	26 30	26 30	28 00	29 35	31 10	34 00
April, May, and June	32 30	28 00	25 00	23 00	22 30	23 20	24 00	27 00	30 00	34 00
July, August, and September	32 30	27 00	25 15	24 00	23 00	23 45	24 00	26 05	28 00	33 05
October, November, and December	32 30	27 40	23 30	22 30	23 10	24 20	26 15	28 00	30 00	33 00

In *January*, *February*, and *March*, by following the points of crossing as indicated, the winds will be found steady from S. to SE.; that is, free as far as the meridian of 10° W. From 10° to 15° W. the winds will predominate from the SE., varying from SW. to S., SE., and NE. From 15° to 20° W. they will predominate from the eastward and NE., hauling at times to N. and NW. From 20° to 42° W. they will blow almost constantly from the northward, varying, however, from E. to NE., to N., and to NW. From 40° to 50° W. they will be still more variable, but at the same time favorable. They will vary from SW., through E., to N., and sometimes to NW., but will predominate from the directions comprised between E and N. Beyond 50° W. the winds will blow 30 per cent. of the time from NE., and will be variable the rest of the time, from S. to SE., E., and N., intermixed with 13 per cent. of calms. The winds often haul to E. at the mouth of the river. (See Route Rio, &c., to Cape Horn, p. 206, for remarks on the land-fall, &c.)

In *April*, *May*, and *June* vessels will carry the SE. trades, that is to say, free winds, as far as the meridian of 15°. From there to 20° W. the winds will blow from SW. to S. and SE.; with SW. winds vessels should steer close-hauled, keeping a good full, however, on the port tack; with S. or SE. winds they should steer a due W. course. From 20° to 30° W. the winds will be exceedingly favorable, and will predominate from SE. to N. From 30° to 35° W. they will predominate from SE. to E. and N. They may, however, sometimes blow from SW., in which case the port tack should be taken. From 35° to 40° W. the winds blow from every point of the compass, but seem to predominate from the northerly quarters. After having crossed 30° S., between 39° and 40° W. (but this should never be done to the westward of 40° W.), the winds will be variable, and oftentimes contrary. They will predominate from N. to NW. and SW. In case of contrary winds, we advise the starboard tack to be taken so long as the parallel of 32° S. is not passed, so as to keep a good distance from the zone of calms lying to the northward of 30° S. and to the westward of 40° W. From 45° to 50° W. the winds will predominate from a northerly direction, and will be more favorable. After having passed the meridian of 50° W. we may expect 15 per cent. of calms, with the winds predominating from N. and NW., and by their aid 34° 30′ S. may be crossed at 52° W. At the mouth of the river there will usually, or rather more generally, be winds from W. to SW. and S., the last accompanied by squally weather, which often renders it difficult to sight the land at the entrance to the river. (See Route Rio, &c., to Cape Horn, p. 206, for the land-fall, &c.)

In *July*, *August*, and *September*, by following the points of crossings, as indicated in the preceding table, the winds found will be trades, well established from SE. These will prevail as far as the meridian of 8° W. They will then predominate from an easterly direction until 33° W. is reached. From 33° W. to 40° W. they will be rather variable,

but predominating from E. to NE. and N. From 40° to 45° W. they will blow oftener from SE. to NE. and N. From 45° W., crossed at 30° S., the winds will generally be favorable, and will predominate from NE. to N. and NW., with 8 per cent. of calms. This will be the case as far as the meridian of 50° W., which should be crossed at or about 33° 05′ S.; however, in this portion of the route we may count on 20 per cent. of chances in favor of SW. winds. After having passed to the westward of 50° W. there will be 25 per. cent of SW. winds; consequently, vessels may often be very much retarded. (See Route Rio, &c., to Cape Horn, p. —, land-fall, &c)

When to the southward of the parallel of 30° S. *pamperos* and *suestadas* may be expected. As a general thing fogs and bad weather are frequent at this season, and particularly off the mouth of the river.

In *October*, *November*, and *December*, by following the points of crossing as laid down in the table, the winds experienced will be well-established SE. trades up to the meridian of 10° W. From there to 15° W. they will be persistent from N., but varying at times to NE. From 15° to 27° W. the winds will be variable from SE. to E. and NE.; or in other words, favorable. From 27° to 40° W. they will be the same, prevailing, however, from a more northerly point, while varying from SE. to E. and NE. From 40° to 50° W. they will be very variable in direction, although prevailing from NE. to N. In this portion of the passage, if SW. winds should be encountered, the port tack, heading WNW., should generally be preferred. The winds will, however, haul to the southward, SE., and NE., and a good run may then be made for the intersection of 33° S. and 50° W. Beyond this meridian the winds will blow principally from NE., accompanied, however, by 11 per cent. of calms, and 34° S. may be crossed at 52° 25′ W. When nearing the land the breezes will be found to blow from NNW. at night, and from E. to SE. by day.

Route from Montevideo to the Gaboon River.—The route for vessels leaving Montevideo and bound for the Gaboon River is the same, as far as 20° S., as the route for vessels starting from the same port and bound to the line (see Route Montevideo, &c., to the Line, p. 221). They should, however, conform to the following instructions, as given for each season of the year:

In *January*, *February*, and *March*, after having crossed 20° S. at 26° W., vessels will find themselves in the position indicated for vessels bound from Rio to the Gaboon, p. 216, in the same season. It will suffice, then, to refer to what has been said in that section for instructions respecting the second part of this route.

In *April*, *May*, and *June* the parallel of 20° S. should be crossed at 27° 30′ W., as was said in Route Montevideo, &c., to the Line, p. 221). From this point to the Gaboon the instructions, p. 216, for vessels sailing from Rio for the same place, in the same season, should be followed.

In *July*, *August*, and *September* the instructions contained in Route Montevideo, &c., to the Line, p. 221, will conduct vessels to 25° S. in the vicinity of 24° W.; and 23° S. between 23° and 24° W.; from which point well-established SE. trade-winds may be expected, and these will allow 20° S. to be easily crossed at somewhere between 21° and 22° W.

Vessels sailing from Montevideo for the Gaboon River, in this season, should cross 20° S. between 21° and 22° W.; while those sailing from Rio at the same time and for the same place generally cross 20° S. somewhere between 28° and 29° W. The second part of the passage, that is, from 20° S. to the Gaboon, is much easier then for vessels sailing from Montevideo than for those sailing from Rio, since the first are much farther to windward than the latter. The parallel of 5° S. should be crossed at or about 3° W., and the passage will end as pointed out in Route Rio to the Gaboon, p. 216.

In *October*, *November*, and *December*, by following the directions contained in Route Rio to the Gaboon, p. 216, the parallel of 20° S. will be crossed in the vicinity of 22° 30′ W. Beyond this parallel the trades will be found variable from SE to E., blowing as frequently from one as from the other of these directions. With these winds the course cannot be any better than NE., particularly if a good full is carried, and this is by all means recommended. In this way the parallel of 17° S. may be crossed at or about 20° 10′ W., and from that moment fixed or steady SE. winds may be counted on, and with them vessels may run, with the wind free, to cross 10° S. at 6° W.

From this latter position the winds will be variable from SSE. to SW., which will permit a good run to be made, so that 7° 30′ S. may be crossed at 2° 20′ E., and 5° S. at 5° E. The course should then be, with winds varying from S. to SW. and W., to cross the equator in the vicinity of 8° E., and the voyage may then be finished without finding a single chance of calms. The small *détour* which we recommend is made to avoid the zone lying between 8° and 5° S. and 0° and 5° E., in which there are 9 per cent. of chances of calms, which might cause a delay of two or three days to sailing vessels and a day's expenditure of coal to auxiliary steamers.

Route from the Gaboon River to Montevideo.—This route, like that from the Gaboon to Bahia, spoken of on p. 200, is very simple indeed. We refer the reader to what has been said in that section in regard to the first part of the route, and we shall proceed to give some advice concerning the latter part.

In *January*, *February*, and *March*, after having crossed the meridian of 10° W. somewhere between 3° and 4° S., the course should be, with the winds constantly from SE., SW. by W. true, carrying the upper studding-sails if possible; this leads to cross the meridian of 30° W. at 16° 30′ S. Beyond this point the winds will be variable from SE. to NE. and N., and with them vessels may head a point farther to the southward, making SW. or SW. ½ S., so as to cross 25° S. at 38° W.

The passage should then be brought to a close, following the instructions contained in Route Line to Montevideo, p. 219.

In *April*, *May*, and *June* the meridian of 10° W. should generally be crossed between 4° and 5° S. Beyond this point the winds will be established at SE., but may vary to E. and NE., and these chances continue until the meridian of 30° W. is reached at or about 21° S. From this point the winds will be found to be variable, although predominating from SE. to NE., and with them 25° S. may be crossed somewhere between 35° and 35° 30′ W. The winds will then be variable from SW., through S. to NE. and N., predominating from the latter point, which, as a general thing, will permit 28° S. to be crossed at 40° or 40° 30′ W. without very great difficulty. From there to 30° S., crossed at 45° W., there will be about a dozen chances of calms, and the winds will predominate from SE. to E. and N. Care should be taken not to get to the westward of 45° W. before reaching the parallel of 30° S., for in that case vessels would fall into a zone containing 23 per cent. of calms.

From 30° S., crossed at 45° W., the route will be governed by the instructions contained in Route Line to Montevideo, p. 219, for the same season.

In *July*, *August*, and *September*, after having crossed the meridian of 10° W. somewhere between 3° 30′ and 4° S., vessels should steer directly, with the trades well established at SE., to cross the meridian of 30° W. at 16° 30′ S. Then the winds will vary from SE. to E. and NE., and will haul more and more to the northward as the coast of America is approached. The parallel of 25° S. should be crossed at 40° W., and 29° S. at 45° W., as the winds will generally be favorable from SE. to NE., with only 8 per cent. of calms. Beyond the parallel of 29° S. the passage should be conducted as laid down for vessels bound from the line to Montevideo, p. 219, during the same season.

In *October*, *November*, and *December*, after having arrived to the southward of the line and to the westward of 5° W., the winds will be found blowing steadily from SE., and with them the studding-sails may be carried by heading W. by S., or even W. true, without the least anxiety in regard to making southing.

When the meridian of 10° W. is reached the winds will be seen to haul fair and to come out at SE., so that vessels may come gradually to the southward, and may steer to make the following crossings: 15° S. at 30° W.; 20° S. at 34° W.; and 25° S. at 39° W. Following this route, when beyond the meridian of 25° W., the winds will be seen to vary rather often to E.; then, after passing 30° W., to predominate from ESE. to ENE.; and from 33° to 39° W., which last should be crossed at 25° S., they will vary from SE. to N., predominating, however, from NE.

Beyond the parallel of 25° S. vessels should conform to the instructions given, when speaking of vessels bound from the line to Montevideo, p. 219, at the same season.

CHAPTER IX.

ROUTES ACROSS THE SOUTH ATLANTIC—CONCLUDED.

Route from Senegal to Brazil.—Upon leaving Senegal in *January*, *February*, or *March*, the first winds met with will be the NE. trades, blowing steadily and strong, and with them a course may be steered, the wind being free, to cross 10° N. at 21° 20′ W., and 5° N. at 25° 30′ or 26° W. From this point to the equator the course is the same as given in Route France to the Equator, p. 71, of the "*Instructions for navigating the North Atlantic Ocean;*" then after crossing the line the remainder of the voyage to any port on the coast of Brazil should be in accordance with the instructions given in Route Line to Bahia, p. 186, Route Line to Rio, p. 202, or Route Line to Montevideo, p. 219, in the present "*Instructions for navigating the South Atlantic Ocean.*"

In *April*, *May*, and *June* the best plan we know of is to make every endeavor to get to the westward without *trying to make southing*, so as to cross the meridian of 20° 30′ W. in the quickest possible time. When to the eastward of this meridian vessels will have to contend with 16 per cent. of calms, and the winds will be variable from NNE. to NNW. and WNW., predominating from the latter point. On the other hand, to the westward of the meridian of 23° 30′ W., there are but 4 per cent. of calms, and the winds are well established from NNE.; so that vessels may easily steer to cross 10° N. somewhere between 26° and 26° 30′ W.

By taking this precaution, vessels when between 10° and 5° N. may count on well-established E. to NE. winds, with only 9 per cent. of calms, and they may then, without the least difficulty, cross 5° N. at a point varying between 23° and 28° W., according to the month of the year. In regard to this subject we will refer the reader to what is said in Route France to the Equator, p. 71, of the North Atlantic instructions.

For that part of the route lying between the equator and the coast of Brazil, we would refer to Route Line to Bahia, p. 186, Route Line to Rio, p. 202, Route Line to Montevideo, p. 219, according as the port of destination is Bahia, Rio, or Montevideo.

In *July*, *August*, and *September* the route to be taken upon leaving Senegal is altogether different from the one recommended for the preceding season. At this time of the year every effort must be made to get to the southward by trying to keep in the vicinity of the meridian of 18° 30′ W. The winds will be generally from NW., but varying to

WSW. and SSW. By keeping near the above-mentioned meridian only 2 or 3 per cent. of calms will be experienced, while to the westward of 20° W. and to the northward of 10° N. at least 11 per cent. may be counted on.

When to the southward of the parallel of 10° N. the winds will be from the southward, but will haul more and more to the southward and westward in proportion as westing is made; as also there will be but 6 to 8 per cent. of calms; the chances of light breezes also increase toward the westward. To sum up, after 10° N. shall have been crossed in the vicinity of 19° W., the port tack should be taken with southerly winds; and when they haul to SSW. or SW., vessels should go about. In this way 5° N. may generally be crossed in the vicinity of 21° W.; but no anxiety need be felt if this parallel has to be crossed 2° or 3° farther either to the eastward or the westward. All along the belt between 5° N. and the equator, the winds will be from SSW. hauling to S., and soon after to SE. With S., and *à fortiori* with SSE. and SE. winds, vessels should steer with a good rap full on the port tack, without fear of making too much westing, provided they do not cross the line to the westward of 24° or 25° W.

After crossing the line, vessels should conform to the instructions given in Route Line to Bahia, p. 186, Route Liue to Rio., p. 202, or Route Line to Montevideo, p. 219, according to where they may be bound.

In *October*, *November*, and *December* the chances of calms are very great between 10° N. and the equator, especially from the coast of Africa to the meridian of 25° W. (see Calm zones, p. 101). Thus it may be seen that it is indispensably necessary to distinguish between the route for sailing vessels and that for auxiliary-steam ships.

Auxiliary steamers leaving Senegal under sail, with the winds from ENE. to NNE., and accompanied by only 8 per cent. of calms, should steer to cross 10° N. at 20° 30′ or 21° W.; after which they will continue under sail while the winds permit; but it is more often the case that they will be obliged to get up steam, and with that make a south course, from 10° to 5° N., as in that belt there are at least 25 per cent. of calms, without taking account of the light airs. Then, from 5° N. to the equator, there will be 15 per cent. of calms, with the winds better established from S. to SE.; and with them the fires may be hauled, and a course on the port tack steered so as to cross the equator between 25° and 28° W. The passage will then be brought to a close by carrying out the instructions as given in Route Line to Bahia, p. 186 Route Line to Rio, p. 202, Route Line to Montevideo, p. 219.

Sailing ships upon leaving Senegal will find the winds the same as above, and should steer to cross 12° 30′ N. at 23° W.; 11° N. at 25° 30′ W., and 10° N. also at 25° 30′ W. From this point to the equator they should follow the directions given in Route France to the Equator, p. 71, of the North Atlantic instructions. Beyond the equator they should conform to the instructions given in Route Line to Bahia, p. 186,

Route Line to Rio, p. 202, and Route Line to Montevideo, p. 219, for the South Atlantic Ocean.

Route from Bahia or Pernambuco to Senegal.—Leaving Bahia or Pernambuco, and bound to Senegal, vessels should, at first, conform to the instructions given on p. 25 for vessels bound to the Gaboon River. However, the route must be slightly modified in the tradewind region, by steering to cross the equator as near as possible to the following points, at each season of the year:

In *January*, *February*, and *March:* At this season the equator should be crossed somewhere between 12° 30′ and 13° 30′ W. From there a course should be steered, with the winds steadily at SSW., but interrupted by about 10 per cent. of calms, to cross 5° N. at 15° W. Beyond this point 17 per cent. of calms, as well as winds varying from NE. to NW., may be counted on, and with these winds vessels can steer to cross 7° N. at 16° 30′ or 17° W., and 10° N. at or about 17° 30′ W. After passing the last-mentioned parallel, no more calms will be experienced. To the eastward of the meridian of 20° W. the winds will be from NE. to NW., while to the westward they will be from NNE. to ENE. However, if upon leaving 10° N., the precaution is observed of taking the starboard tack when the winds blow from E. to N., and the port tack when they blow from W. to N., the parallel of Goree may generally be crossed at 20° W., and that of Saint Louis at least at 21° W. As a general thing, when the port of destination is brought to bear east, vessels may go about and fetch there on the other tack.

There is one very important thing which must be kept in mind the whole year round, and that is, that great attention must be given to the currents on that part of the route lying between the line and Senegal. At first the equatorial current sets strong to the westward, and this extends to about 3° N.; following this will be found the Guinea current and then the coast of Africa current, directly ahead. We must refer the reader to the remarks as contained in Currents South Atlantic, p. 116, on this subject.

During the season of which we are now speaking, this voyage is comparatively easy to vessels of ordinary sailing qualities. Of course, auxiliary-steam ships may shorten it slightly in case they get into a region of persistent calms; but as a general thing, a well-handled sailing vessel may make a very good passage.

In *April*, *May*, and *June* the line should be crossed, as in the preceding season, between 12° 30′ and 13° and 30′ W. Between the equator and 5° N. there will be 8 or 9 per cent. of calms, and the winds will be from the southward, so that the parallel of 5° N. may be crossed at 15° 30′ W. From 5° to 10° N., we may expect 18 per cent. of calms, with breezes rather variable, although dominant from SSW., so that 10° N. ought to be crossed at or about 17° 30′ W.

Beyond 10°N., and to the eastward of the meridian of 20° W., there will be about 17 per cent. of calms, and the winds will be NNE. to NNW.

and WNW.; they will, however, predominate from the latter direction. With the winds from NNE. to NNW., which they will be 40 per cent. of the time, it will be natural for vessels to take the starboard tack, and to go about when the wind comes out at NW. or WNW. There are also 40 per cent. of chances in favor of these latter breezes.

Vessels bound to Goree may thus reach their destination. Those bound to Saint Louis should endeavor to cross 15° N. at 19° W., from which point they may generally reach the anchorage off the bar, as the winds are well established from NW., varying to WNW. However, in this latter part of the voyage, from 15° N. to Saint Louis, there are exceptional winds from ENE. to NNE., which are of short duration. At no time need calms be feared.

The route just given is undoubtedly the best for *auxiliary-steam ships*. Of course, if they encounter persistent calms, the fires may be lighted and the run up the coast made without any difficulty. When the wind does blow it will generally be favorable.

In the case of *sailing vessels*, which have to make a distance of some 200 leagues through a region in which there are 17 or 18 per cent. of calms, and a current of 12 to 20 miles against them, of course their passage will be a long one. But fast sailers may modify the route in the following manner:

After crossing 5° N. at 15° 30′ W., as the winds will generally predominate from SSW., they may steer to cross 10° N. at 20° or 20° 30′ W. Beyond this point the winds will be better established in proportion as westing is made. They will blow nearly at the time from NNE., but will haul exceptionally to ENE. By these means the parallel of Goree may be reached at or about 24° 30′ W., at which time the tack should be changed, and in all probability the anchorage may be gained on that board. However, it must be remembered that, without counting in the prolongation of the route, calms and light breezes must be expected after getting to the eastward of the parallel of 20° W. Vessels bound to Saint Louis should have a care not to stand any farther to the eastward, on the parallel of 24° N., than the meridian of 20° 30′ or 20° W. When this point is reached they should go about and make a good run to the NW., taking advantage of every variation of the wind from NNE. to the eastward, so as to reach 15° N. in the vicinity of 21° W. When that point is reached vessels should go about for the last time, and, unless the wind hauls to the eastward, as it occasionally will, Saint Louis may usually be reached on that board; because the winds almost invariably haul to NNW. and WNW., as easting is made, after passing the meridian of 20° W. to the northward of 15° N.

To sum up, the passage from the line to the Senegal is very tedious at this season. Not only is the current unfavorable, as it is at every season, but the calms are much more persistent than during either the preceding or the subsequent season. Finally, it is important to mention that in following the route as indicated in these instructions and

which we consider the best, there will be at least four hours of rain per day between the line and 2° N., seven hours per day between 2° and 6° 30′ N., and about four hours per day when between 6° 30′ and 9° N.

In *July*, *August*, and *September:* At this season the passage will be extremely easy, thanks to the well-established monsoon of the coast of Africa.

Vessels leaving Pernambuco and Bahia may easily steer to cross the line between 24° and 25° W., as the winds will be well established and varying from SE. to S. After crossing the equator they will predominate from the southward varying to SE. (but without calms), and will permit 5° N. to be crossed at 20° W.

From 5° to 10° N., there will be but 6 per cent. of calms, with the winds from the southward, varying to SW., so that a course to cross 10° N. between 19° and 19° 30′ W. may easily be made.

Goree: Beyond 10° N. vessels bound to *Goree* should steer, with the winds well established from NW., WSW., and SSW., in a way to cross 13° N. at 18° 30′ W., and may then, without the least difficulty, make a course for their port of destination.

Saint Louis: Beyond 10° N. vessels bound to *Saint Louis* should take advantage of every series of westerly winds to make all the northing possible in the neighborhood of 19° 30′ or 19° 40′ W. In this way they may gain excellent position from which, when the wind hauls to WNW. or NW., they may make a good run on the port tack. When standing to the northward and nearing 15° N., every effort should be made to get to the westward, so as, if possible, to cross 15° N. between 20° and 20° 20′ W., but not to the westward of the latter meridian. Winds from NNE. to NW. prevail to the northward of 15° N., and they blow about equally from these two directions. From this it results that vessels having crossed 15° N. at 20° or even 19° W., may generally reach Saint Louis by running on the port tack after crossing the parallel above mentioned.

It is thus that good sailing vessels make such fine passages at this season, and auxiliary steamers have but a very slight advantage over them. The currents will be ahead (see Currents, &c., p. 116), but calms will be very rare. The following are the number of hours of rain to be expected in the different localities: between 6° and 7° N., 4 hours; between 7° and 10° 30′ N., 7 hours; and between 10° 30′ and 12° 30′ N., 4 hours per day.

In *October*, *November*, and *December* the passage is very difficult at this season for *sailing vessels*. Auxiliary steam vessels overcome the difficulties by the means of their steam power. We shall give two routes: the *first* is for all auxiliary steam vessels and some of the sailing ships; the other is to be taken by those sailing vessels which can work to windward against the trades. We shall add that sailing ships will do well not to attempt this voyage at this season of the year, unless absolutely forced to do so.

First route: Leaving Bahia, vessels should steer to cross the line between 13° 30′ and 14° W.; leaving Pernambuco, they should haul to the wind, and try to reach the equator as far to the eastward as possible, say at 15° 30′ or 15° W.

Above the equator, when to the westward of the meridian of 15° W., there will be 18 per cent. of chances of calms, and 9 per cent. only when to the eastward of that same meridian. It will be advantageous then to steer, with the winds blowing from SSE. to SSW., so as to cross 2° N. between 13° 30′ and 14° W.; 3° N. at the same longitude and 5° N. at 15° 30′ or 16° W.

Between 5° and 10° N., and to the eastward of 15° 30′ W., there are 35 per cent. of chances of calms, while to the westward of that meridian there are but 28 per cent., although this is a very large amount. The prevailing winds in this last region will first be those from SW.; then from SE. to NE. Consequently, when not retarded by dead calms and there is breeze enough to overcome the strength of the current, it will be easy to steer so as to reach 10° N. at 18° W. In this portion of the route auxiliary steam vessels will have a great advantage, as they may start fires and steam through; in this case it will be best to cross 10° N. at 17° 30′ W.

Beyond 10° N. there will only be 8 per cent. of changes of calms, and the winds will be generally from NNE., but variable to ENE. Vessels should then hug the wind on the starboard tack, taking advantage of every favorable change, and going about when the parallel of Goree is reached. This rule admits of an exception, and that is, that in case NNW. winds are met with, which often happens when near 15° N., vessels should go about immediately.

Vessels bound to Saint Louis should prolong the board on the starboard tack until the parallel of the anchorage, that is the bar of the Senegal, is reached. To the northward of 15° N. the winds will predominate from NNE., but will vary to NE. and NW. With the NNE. winds, vessels should take the starboard tack, but, at the same time, they should not prolong that board to the westward of 19° W., as they will have every advantage in tacking when that meridian is reached. When the winds are ENE., or even NE., the starboard tacks should be kept aboard until the parallel of the bar is gained; there will then be less disadvantage in going about. When the wind comes out at NW. all possible sail should be carried, and vessels should head well up to the northward of the anchorage, so as to be as far to windward as possible in case the breeze again hauls to NNE.

We consider this first route the better, or, at least, most always the shorter, in spite of the unfavorable circumstances which exist between the parallels of 5° and 10° N., where vessels may be retarded a very great deal. We may remark, in favor of this route, that it passes outside of the zone of persistent rains which always make a voyage so ex*ceedingly uncomfor*table, and particularly so to passenger ships.

Second route: This second route is for sailing vessels of extraordinary sea-going qualities, and capable of sailing almost in the wind's eye, such as full clippers.

These vessels may cross the line between 26° and 36° 30′ W., and and then make a due north course as far as 10° N. Between 0° and 5° N. they will experience some 10 or 11 per cent. of calms, and the winds will be generally from SE., but variable to E. and S. From 5° to 10° N. the chances of calms will be 17 per cent., and the winds, although predominating from E., will be variable from NE. to E., SE., and S. In this portion of the route the number of hours of rain per day will be: between 2° and 4° 30′ N., 4 hours; between 4° 30′ and 8° 30′ N., 6 hours; and between 8° 30′ N., 4 hours.

Beyond 10° N., which should be crossed at 26° W., there will only be 6 per cent. of calms, while the winds will predominate from the eastward, varying, however, to NE., and with them vessels should steer full and by, but without attempting to force to the eastward. By steering carefully, and taking advantage of every favorable slant, the course made will generally be N. ½ E., or perhaps N. by E., and the parallel of 13° N. may be crossed at 25° or 24° 40′ W. From this latter point will begin a very heavy piece of working to windward, with the winds generally at NNE., but varying at times to ENE. The chances of calms will be about 8 or 9 per cent. when to the southward of 15° N.

The following may be taken as the general rule to be observed when working to windward: When the wind blows from between the points of NE. and SE., the starboard tack should be taken until the parallel of the port of destination is reached. On the contrary, when the wind is from any point to the northward of NE., the port tack should be taken and kept as long as the proximity of the land will permit. As a general thing, when to the southward of 15° N., the chances in favor of working to windward will be better to the westward of the meridian of 20° W., because in that region very favorable SW. to SE. breezes are often encountered, and these are never felt to the eastward of that meridian. Consequently, vessels *bound to Goree* may cross 14° N. at 25° W.; and from there will be in the best position to receive the NNE. to ENE. winds, which prevail beyond 20° W. Vessels *bound to Saint Louis* should try to cross 15° N. at 25° 30′ W., and may then steer, according to the winds encountered; and these will blow 50 per cent. of the time from NNE, and 20 to 25 per cent. from ENE., and about the same percentage of the time from NNW.

Route from Rio de Janeiro to the Senegal.—Leaving Rio, bound for the Senegal, vessels should conform to the instructions given on p. 203 and p. 216, when we spoke of vessels bound to the line or to the Gaboon River. When they encounter the trades well established, they should steer to cross the equator at the following longitudes:

From *January* to *June*, between 12° 10′ and 13° 10′ W.

In *July*, *August*, and *September*, the equator should be crossed at 21° 30′ W. and the parallel of 5° N. at 20° W.

In *October*, *November*, and *December*, the equator should be crossed between 13° 30′ and 14° W., or else between 26° and 26° 30′ W., according to which of the two given routes may have been chosen.

From the equator to the Senegal we need only refer the reader to what has been said in the preceding section in regard to the route from Bahia to the Senegal.

Route from Montevideo to the Senegal.—Leaving Montevideo and bound to the Senegal, vessels should first confine themselves to the advice given on p. 221 and p. 238, when speaking of vessels bound to the Gaboon. So soon as well-established trade-winds are encountered, they may steer to cross the equator at the following points:

From *January* to *July*, between 12° 30′ and 13° 30′ W.

In *July*, *August* and *September*, the equator should be crossed at 21° 10′ W. and the parallel of 5° N. at 20° W.

In *October*, *November*, and *December*, the line should be crossed either between 13° 30′ and 14° W., or between 26° and 26° 30′ W., according to which of the two routes may have been chosen. (See these routes on p. 243.)

After having crossed the equator vessels should follow the same points of crossings as are given for vessels sailing from Bahia in the course of on p. —.

Route from the Senegal to the Gaboon.—This route, which we speak of simply to chronicle, corresponds exactly with the latter part of the route from France to the Gaboon River, and was given in detail on p. 65 of the "*Instruction for navigating the North Atlantic Ocean.*" However, we shall give for each season the advice which we think necessary for the first part of the passage. And from that it will be seen that there is no difficulty, except from April to October, in making the passage from Senegal to the parallel of 10° N.

In *January*, *February*, and *March:* At this season the winds will blow NNE. to NNW., and vessels leaving Saint Louis should lay a course to double Cape de Verde by passing a short distance from it; after that is done, their course corresponds with that of vessels which start from Goree. These last will find the winds predominating from NNE. to WNW., but blowing occasionally from ESE. and with 5 per cent. of calms, and they should steer to cross 10° N. at 17° W.; they may then continue as directed on p. 65 (North Atlantic instructions).

In *April*, *May*, and *June:* At this season the winds will be well established, and in the vicinity of Saint Louis will predominate from NNW., although varying at times to ENE. and WNW., so that vessels leaving that place should steer to cross 14° 30′ N. at 20° W. To the westward of this meridian the winds will be found well established from NNE., provided 13° 30′ N. is crossed at 21° W., and a S. course then made to *cross 10° N. between* 21° and 21° 30′ W.

But vessels leaving Goree at this season should make all possible westing, avoiding at the same time any southing, otherwise they would fall into a region containing from 16 to 18 per cent. of calms. The winds will be variable from NNE. to NW., but will predominate from NW. As a general thing, 13° 30′ N. will be crossed at 20° W.; 12° 30′ N. at 21° W.; and from this point a good run to the southward may be made by keeping between 21° and 21° 30′ W., until 10° N. is reached.

The détour recommended is for the purpose of avoiding, at least in part, the persistent calms which prevail to the northward of 10° N. and between the coast and 20° W. It also has the advantage of placing vessels in a better position from which to steer with the prevailing SSW. winds, which are to be found to the southward of 10° N.

After having crossed 10° N. at 21° W., the remainder of the passage should be made as directed on p. 65 (North Atlantic instructions).

In *July*, *August*, and *September*, as the winds will predominate from NE. to NW., it will be prudent, when leaving Saint Louis, to steer to cross 15° N. at 19° W.; 13° N. at 20° 20′ W., and 10° N. close to 21° 10′ W. By following this route there will be nothing to fear, except the 10 or 11 per cent. of calms which prevail to the westward of the meridian of 20° W.

After having crossed 10° N. at 21° 10′ W., the route should be continued as laid down on p. 65 of the *North Atlantic instructions*.

Vessels leaving Goree will find the winds varying from NW. to WSW. and SSW. until 10° N. is reached, and then between 10° and 5° N. they will be from the southward. They should therefore take the precaution of getting to the westward as far as possible while the winds permit, so as to be able, in case circumstances do not oppose, to cross 10° N. in the vicinity of 20° W. The farther to the westward 10° N. is crossed the better will be the position from which to continue the route on the starboard tack, when the winds come out, as they certainly will, from the southward.

At least 7 hours per day of rain may be looked for when between 11° and 6° N.

In *October*, *November*, and *December*, vessels leaving Saint Louis will find the winds from ENE. to NNW. predominating and well established from NNE., and by their aid Cape de Verde may easily be doubled at a short distance off shore. Beyond this point these vessels, as well as those leaving Goree, should steer, the winds being variable, from ENE. to NNE., with 8 or 9 per cent. of calms, to cross 10° N. at 17° W. The voyage may then end as directed on p. 65 of the *North Atlantic instructions*.

Route from the Gaboon to the Senegal.—No matter what the time of year or the point in the Gulf of Guinea from which vessels start, they should always steer, first to the southward so as to reach the equator in the quickest possible time, and then along the line to the westward. From May to December they may run along 1° N., and

on 0° 30′ or 1° S. during the remainder of the year. The course should not trend to the northwest until a convenient longitude, according to the season, is reached.

In *January*, *February*, and *March*, as the calms reach nearest to the equator at this season, vessels should run down their westing on the parallel of 1° or 1° 30′ S., and cross the line again at 12° 30′ W.; after which they may continue their passage to the Senegal by conforming to what was said in Route Bahia to Senegal, p. 243, for the latter part of the voyage.

In *April*, *May*, and *June*: At this season the westing should be made along the equator, but not to the southward of 0° 30′ S., and the course may begin to trend to the northwest when 10° W. is reached; the line should be crossed at 10° 30′ W., and vessels may then steer, the winds being from S. with 8 per cent. of calms, so as to cross 5° N. at 15° W. After having reached this point, continue as recommended in Route Bahia to Senegal, p. 243.

In *July*, *August*, and *September*, the westing should be made, the winds being from SSW. to SSE., along the parallels of 1° 30′ N., commencing to make northing when the meridian of 9° or 10° W. is reached. Vessels may easily run to cross 5° N. at 15° W., and 10° N. at 18° W., as the winds will be well established from the southward. The passage may end as pointed out in Route Bahia to Senegal, p. 243.

In *October*, *November*, and *December*, the voyage is long and disagreeable for sailing ships, and it will be best to avoid it altogether at this season; nevertheless we shall indicate the route for the benefit of those who may be forced to make it.

The westing should be made along a parallel to the southward of the line, 1° S., for instance, until 9° or 10° W. is reached. During this portion of the voyage the winds will be well established and variable from S. to SSW. and SW., as far as 5° W.; then there will be good breezes from S., between 5° and 10° W. Beyond this latter meridian, vessels may steer with the SE. trades, so as to cross the line at or about 13° W.

To the northward of the equator the winds will be from the southward, with 8 per cent. of calms, as far as 5° N., which, by the way, should be crossed very easily at 15° 30′ or 16° W.

Beyond 5° N. the route conforms to that given in Route Bahia to Senegal, p. 243, and should end in the same way as the *first of the two routes* given in that section.

Route from the Senegal to the Cape of Good Hope.—We only mention this route for reference. It is only necessary to say that the first part, between the Senegal and the equator, should be made according to the instructions on p. 242, for the South Atlantic Ocean.

The second part, from the line to the cape, has been fully explained on p. 129 and 137.

Route from the Cape of Good Hope to the Senegal.—When coming from the cape or the Indian Ocean, vessels should first steer as directed in Route Indian Ocean to the Line, p. 135, and Route Cape of Good Hope to the Line, p. 139, and in that way reach the SE. trades, which will be found blowing steadily in the vicinity of 30° S., and between the meridians of 16° 10′ and 8° W.

In *January*, *February*, and *March*, after having crossed 30° S. in the neighborhood of 8° W., a good run may be made, with the winds from SE., to cross 20° S. at 3° 40′ E., and 10° S. at 4° 40′ W. From 10° S. to the line, which should be crossed at 12° 30′ W., the winds will predominate from SE., varying to SSW. The route should be continued, to the northward of the equator, by conforming to the directions as given in Route Bahia to Senegal, p. 243.

In *April*, *May*, and *June*, the parallel of 30° S. should be crossed near 7° W.; then the winds being from SE. and variable to S., 20° S. should be crossed at 2° 50′ E., and 16° 30′ S. at the meridian of Greenwich. From there to 10° S., the winds will be from SE., and that parallel may be crossed at 5° W.; they will then vary from ESE. to SE. and SSW., and 3° S. may be crossed in the vicinity of 10° W. From this point a course may be run, with the winds from SE., to cross the line near 12° 10′ W., and from there to the Senegal, as was said in Route Bahia to Senegal, p. 243.

In *July*, *August*, and *September*, after having crossed 30° S. at 10° 50′ E., a course may be made, the trades being from SE., but variable to S., to cross 17° S. at the meridian of Greenwich; the winds will then be from SE. up to 5° N., which may be crossed at 9° 30′ W., and the line at 13° W. From the equator to 5° N., which should be crossed at 17° W., the winds will vary from SSE. to SSW., and the voyage may then be brought to a close, as was directed in Route Bahia to Senegal, p. 243.

In *October*, *November*, and *December*, after having crossed 30° S. at 11° E., the winds being generally from SE., but varying to S. and SW., a course may be run to cross 20° S. at 3° 30′ E.; 10° S. at 4° W., and the equator at 11° 30′ W. Beyond this the winds will be from the southward, with 8 or 9 per cent. of calms, as far as 5° N., which may easily be crossed at 15° 30′ or 16° W. The remainder of the voyage to the Senegal should be made in conformity to the instructions given for the *first route*, as laid down in Route Bahia to Senegal, p. 243.

Route from the Senegal to Cape Horn.—This, like the route given on p. 250, is simply mentioned for reference. The first part, comprised between the Senegal and the equator, is to be made according to the instructions contained on p. 242. The second part, from the line to the Horn, should be made the same as that spoken of in Route Line to the Pacific, p. 141.

Route from the Horn to the Senegal.—When leaving the Horn, or the western entrance of the Straits of Magellan, vessels should first

follow the instructions given in Return Route Pacific to the Line, p. 152, and Route Straits of Magellan to the Line, p. 174, for those bound to the equator. So soon as they reach the SE. trades, they may steer, without the least difficulty, so as to cross the line as follows:

From *January* to *July*, between the meridians of 12° 30′ and 13° 30′ W.

In *July*, *August*, and *September*, the line should be crossed at 20° 50′ W., and 5° N. at 20° W.

In *October*, *November*, and *December*, the equator should be crossed either between 13° 30′ and 14° W., or between 26° and 26° 30′ W., according to which of the two routes set forth in Route Bahia to Senegal, p. 243, may be chosen.

From the line to the Senegal, vessels must conform to the instructions laid down for that part of the route in Route Bahia to Senegal, p. 243.

Route from the Gaboon to the Cape of Good Hope and the Indian Ocean.—The first part of this route is precisely similar to that set forth on p. 200, for vessels bound to Bahia. Following this are set forth what we consider the best points of crossings which can be taken, as also some remarks upon the manner of bringing the voyage to a close.

In *January*, *February*, and *March*, after having crossed the meridian of 10° W. somewhere between 3° and 4° S., vessels should haul to the wind on the port tack, and run through the SE. trades to cross the parallel of 20° S. at 17° W.

When between 20° and 25° S., there will be 8 per cent. of calms, with the winds prevailing from E., but variable from SE. and S. When the breeze is blowing from E., a S. course should be made; with the winds at SE., full and by on the port tack; and, finally, if the wind comes out at S., which, by the way, rarely happens, the tack should be changed immediately, and an ESE. course made until the wind hauls again to the eastward. To sum up, vessels should make every exertion to cross 25° S. somewhere between 17° and 18° W. Between 25° and 30° S. the winds will predominate from E. to NE., hauling at times to N. and NW., but without calms. The chances are extremely favorable, provided vessels do not get to the eastward of the meridian of 16° W. The best point at which to cross 30° S. will be the meridian of 17° W.

When between 30° and 35° S., every advantage is to be gained by keeping to the westward of the meridian of 15° W., where the winds will be found to be well established and predominating from NW., although quite variable in directions. On the other hand, to the eastward of this meridian there will be at least 7 or 8 per cent. of calms, while the winds, generally from a northwesterly direction, are frequently varied by a series of persistent SW. to SE. breezes. It will be best to cross 35° S. at 15° W.

Beyond the parallel of 35° S., the winds will always be favorable for reaching either the Cape of Good Hope or the Indian Ocean. In the first case vessels should steer to reach 37° 20′ S. at 6° or 8° W.; in the second case, they should run to cross 41° 30′ S. at or about the meridian of Greenwich. The voyages may end as was shown in Route Line to Cape of Good Hope, p. 137.

In *April*, *May*, and *June:* At this season the meridian of 10° W. may generally be reached somewhere between 4° and 5° S. From this point vessels should stand on with a good rap full, on the port tack, heading about SW. by S., the wind being well established from SE., and they can cross 20° S. between 21° 30′ and 22° W.

Between 20° and 25° S. the winds will predominate from E., varying at times from SE. to NE., with some 6 per cent. of calms. It will be very easy then to steer due S., and to cross 25° S. at 21° 30′ W. Here we may remark that it would be an error to haul close to the wind at this season of the year when running through the trades. By steering as advised, the parallel of 20° S. may be reached in the vicinity of 17° W., but head-winds will then probably be met with; and these, when between 20° and 25° S., and 15° and 20° W., will blow from SE. to S. and SW.

After having crossed 25° S. at 21° 30′ W., the winds will be variable, blowing most frequently from NE. to NW., that is to say, nearly always favorable, and with them it will be easy to reach 30° S. somewhere between 19° and 21° W., and 35° S. at 13° 30′ W.

From this latter point vessels may steer, with the general westerly winds, for 37° S. and 5° W., if bound to the cape, or to cross 40° S. at or about the meridian of Greenwich, if bound to the Indian Ocean.

As in the former case, the voyage may be brought to a close by following the directions given in Route Line to Indian Ocean, p. 129, and Route Line to Cape of Good Hope, p. 137.

In *July*, *August*, and *September*, after having crossed the meridian of 10° W. between 3° 30′ and 4° S., vessels should haul close to the wind on the port tack, through the SE. trades, and may reach 20° S. at 17° or 17° 30′ W. From 20° to 25° S. the winds nearly always blow from E., varying at times from SE. to N.; consequently the parallel of 25° S. may usually be crossed between 16° and 16° 30′ W.

From 25° to 30° S. the winds blow most often from SE. to NE. and N. They are consequently favorable, and generally afford every facility for crossing 30° S. somewhere between 15° and 15° 30′ W. However, a south wind may sometimes be encountered, and in such a case no time should be lost in getting on the starboard tack, because the wind will be seen to haul to the eastward the more easting there is made.

Beyond 30° S., crossed at 15° W., the winds will be very variable, but blowing mostly from the westward, and with them 35° S. may be crossed at 10° 30′ W.

From this point vessels bound to the cape should steer to reach 37° S. at the meridian of Greenwich; and those bound up the Indian Ocean should run to cross 40° S. at the same meridian.

The voyage may then end in accordance with the instructions of Route Line to Indian Ocean, p. 129, and Route Line to Cape of Good Hope, p. 137.

In *October*, *November*, and *December*, when vessels get to the southward of the line and to the westward of the meridian of 5° W., they will find the winds blowing constantly from the southward, and should steer with a good rap full, heading W. by S., true.

When the meridian of 10° W. is reached, which will generally be crossed at 2° or 3° S., the wind will haul to the SE., so that a course of SW. by S. may be made by steering with the wind one point free. It will be useless to try to cross 20° S. to the eastward of 22° W.

Between 20° and 25° S. there will only be 4 per cent. of calms, and the SE. trades will often haul to E., or even NE. So, as a general thing, the studding-sails may be carried, and 25° S. crossed at 23° W.

Between 25° and 30° S. the winds blow most often from E. to NE. and N., permitting a true south course to be made. Nevertheless, if a south wind is encountered, as sometimes happens, we would recommend the port tack being taken, as the chances of this wind are much fewer in proportion as easting is made; that is, the farther one gets from the meridian of 20° W.

Between 30° and 35° S. the winds will predominate from N. to NW., and will permit 35° S. to be crossed at 20° W.

Beyond this last point vessels may easily steer, with the general westerly winds, to cross 37° S. at 14° W. if bound to the cape, or 41° S. at the meridian of Greenwich if bound up the Indian Ocean.

In either case the voyage may be ended according to the instructions given in Route Line to Indian Ocean, p. 129, and Route Line to Cape of Good Hope, p. 137.

Route from the Cape of Good Hope to the Gaboon.—This is one of the simplest routes possible, as it has both wind and current in its favor. We shall, however, give the best points of crossings which will enable vessels to make a quick passage.

In *January*, *February*, and *March* the parallel of 30° S. should be crossed between 11° 50′ and 12° 20′ E.; 25° S. between 8° 50′ and 9° 20′ E., and 10° S. between 7° 20′ and 7° 50′ E. During this part of the route the winds will be found from SE., varying to S. Between 10° and 5° S., a due north course should be made, with the winds at south; then between 5° S. and the equator the winds will be from SE. to S., SW., and W., and will permit vessels to steer for the port of destination. By following the points above given there will not be a single chance of encountering calms.

In *April*, *May*, and *June* the parallel of 30° S. should be crossed between 10° 20′ and 10° 50′ E., which may easily be done, as the winds

will predominate from SE. to SSE. between that parallel and the cape. With these same SE. to S. winds a course should then be steered to cross 29° S. at 9° 20′ E., 25° S. at 8° 20′ E., and 10° S. at 7° 20′ E. From this latter point vessels may steer due north, as the winds will be well established, and variable from SE. to S. and SW., as far as the parallel of 5° S. Finally, between 5° S. and the line, there will be 14 per cent. of calms, with the winds variable from WSW. to S., SE., and ENE., but blowing most often from the southward; and with these breezes the voyage may be ended with but little fear of being retarded by calms, even in sailing vessels.

In *July*, *August*, and *September* the same points of crossings should be followed as in the preceding season. The winds will be well established from SE., varying to S., from the parallel of 30° S. to that of 10° S. From 10° to 5° S. the winds will predominate from SW., and vary to S.; from 5° S. to the line, they will vary from W. to SW. and S.

There are no chances of calms in this season.

In *October*, *November*, and *December*, the parallels of 30° S. should be crossed at 11° 20′ E., 25° S. between 8° 50′ and 9° 20′ E., and 10° S. between 7° 20′ and 7° 50′ E. Between the parallels of 30° and 15° S. the winds will vary from SE. to S.; and from 15° S. to the equator from SW. to S. During this season there are no chances of calms.

Route from the West Indies or Guiana to the Brazils.—It is only necessary to examine the pilot charts of winds and currents in the Atlantic Ocean to become convinced that vessels will have every possible chance against them on a voyage from the West Indies to the Brazils. Contrary winds, the equatorial current setting toward the west, calms and rains are the pleasant companions of this passage. We are inclined to think that this route is about the most difficult of any, and consequently it is exceedingly embarrassing to attempt to lay down any fixed rule of conduct in regard to it.

The oldest route, given for sailing-ships, may be followed at all seasons of the year. It is made by taking the starboard tack upon leaving the West Indies or Guiana, as though bound to Europe (see p. 58 and p. 19 of North Atlantic instructions); then, after having gained the region of general westerly winds, running to the eastward on thirty-fifth parallel so as to gain the points of crossing laid down for vessels bound from the United States to the equator. (See p. 86, North Atlantic.) This route is very long, and we think there is a better one, at least for sailing-vessels, which may be used for nine months of the year.

The old route is at least 500 leagues longer than the one we are about to give for the months comprised between December and October. M. Tardy de Montravel has counseled vessels to steer along a little to the northward of the limit of the equatorial current, when sailing from Guiana and bound to Brazil, so they may profit by the counter-current setting to the eastward; this is felt between the northern limit of the equatorial current and 10° N. latitude. (See p. 30, North Atlantic). We

have studied this direct route very thoroughly, and we shall now give the advice which we think it will be advantageous to follow.

We must repeat that this is a very rough trip for *ships using sail alone.* Small steamers, but poorly masted, should never undertake the voyage; for one which might accomplish it, ten would be sure to fail. Well-masted auxiliary-steam vessels are much better even than sailing-ships, for they may at any time get up steam to help them along. But we shall, in the following remarks, speak solely of sailing-ships proper, and those, too, of good qualities. It will be easy to more or less modify these instructions when in auxiliary-steam vessels, according as greater or less attention is paid to the expenditure of coal. Again we say that small auxiliary-steam vessels, or even dull sailing-ships, had better not try the voyage at all; unless, be it well understood, they have no objection to making a very great détour, passing in the vicinity of the Bermudas and the Azores.

In *January, February,* and *March:* First of all, we advise tracing on the chart a line passing through the following points of crossings: 7° N. at 35° W., and 17° 30′ N. at 60° W.; this line will lie in a WNW. and ESE. direction. This done, no matter what the starting-point, vessels should make every effort to place themselves to windward of this line.

When leaving Guiana they should take the starboard tack, and should prolong that board as far as may be necessary. As the winds will be from NE. this board will run NNW. true, and vessels should should not go about until after having passed the above-mentioned line.

Upon leaving the West Indies vessels may take the port tack, heading ESE. until the meridian of 51° W. is reached; at that time they should go about and keep on the starboard tack until the given line shall have been crossed. By working in this way, well-established NE. winds will be found, while to the northward of 15° N. they will be variable from the eastward, that is to say, much less favorable.

After having passed the line, and taken the port tack, vessels should always have a care to keep a little to windward of it. In this way 9° 30′ N. may be crossed at or about 40° 10′ W., and 7° 30′ N. at 35° 10′ W. From this latter point the winds will be from NE., variable to E., and the course made cannot be better than SE.; so that 5° N. may generally be reached somewhere between 32° 30′ and 33° W. Between this point and the line about 9 per cent. of calms, and four hours per day of rain, may be expected; the winds will predominate from NE., but will often vary as far as ESE. With these chances of winds the hope of reaching the line between 30° 30′ and 31° W., or even farther to the eastward, may be entertained.

Beyond the equator the passage may be brought to a close according to the directions given in Route Line to Bahia, p. 186, Line to Rio, p 202, or Line to Montevideo, p. 219.

In *April*, *May*, and *June:* At this season a line joining 10° N. at 40° W., and 17° 30′ N. at 57° 30′ W., should be traced on the chart. This line, running in an ESE. and WNW. direction, represents the route to be followed, or rather the limit to windward of which vessels should always keep.

When leaving Guiana it is well to take notice that there are 25 per cent. of chances of calms between the meridians of 50° and 55° W., and from the mainland to the parallel of 10° N. It will be advisable then for auxiliary-steam vessels to light fires to get beyond this zone, and for sailing-vessels to take the port tack and prolong that board to the meridian of 46° W. At this point they should go about and stand to the NNW., on the starboard tack, until the limit-line is passed.

When starting out from the West Indies, vessels should take the starboard tack as soon as possible. The winds will generally be found predominating from the eastward, but varying from NE. to SE.; and with them vessels should make all possible way to windward. It will be best, if the winds are persistently from the eastward, and particularly if they hang at SE., to get at least 50 miles to the NE. of the above-mentioned limit-line.

When the port tack is finally taken, after having gained sufficiently to windward, it should be kept until 10° N. is crossed at 40° W. This may easily be done, as the winds will predominate from NE. and blow very fresh; between 10° and 8° N., which last should be crossed at 35° 30′ W., they will still blow from NE., but there will often be 6 or 7 per cent. of calms. Beyond 35° 30′ W. the winds will decidedly predominate from NE., but they will often haul to E. and SE.; in which case the starboard tack should again be taken. Unfortunately, there will then be about 18 per cent. of calms, and sailing-vessels will be a long time in reaching 30° W. at 6° N. Auxiliary-steam vessels may run the greater part of the 300 miles between 35° and 30° W., under steam, and may reach the latter meridian in the vicinity of 8° N. We may say that, during this part of the voyage, the current will be favorable.

Beyond the points of 30° W. at 8° N., and 30° W. at 6° N., vessels will enter a zone where the breezes will be better established from NE. to E., blowing at times from S. or N., with only 8 or 9 per cent. of calms. It will be best when in this region to follow this rule of conduct: Take the starboard tack with easterly, and the port tack with NE. winds; making due E. when possible, which, by the way, will be very rare. In this way 5° N. may undoubtedly be crossed somewhere between 26° and 27° W., which is the best position.

Leaving 5° N., which should be crossed as near as possible to 26° 30′ W., there will be 18 per cent. of calms, with winds predominating from SE., but variable from SE. to E. and NE. When the wind comes out at S. the starboard tack should be taken; and with winds from SE. the port tack. Finally, if the breezes haul to E. or NE., the course may be run

to reach the equator at 28° W. Auxiliary-steam vessels may light their fires to shorten this new portion of the route.

To the southward of the equator the winds will be well established from SE., and the course may be laid for the Brazils as was directed in Route Line to Bahia, p. 186, Line to Rio, p. 202, and Line to Montevideo, p. 219.

In *July*, *August*, and *September:* At this season the line drawn on the chart should pass through the points 20° N. at 60° W., and 14° N. at 55° W. And this latter point should then be joined by a line with the point at 10° N. and 47° 20′ W.

This broken line represents the limit to windward of which vessels leaving Guiana or the West Indies should at once endeavor to place themselves. In order to do this they should first take the starboard tack, and stand on until a position some 50 miles to windward of the limit-line is gained.* When this is done the port tack should be taken. On this board the course should be SE., true, until 14° 30′ N. is crossed at or about 55° W. Beyond this point the winds will be found settled at NE., and the course may be ESE. until 10° N. is crossed near 49° W., or even farther to the eastward if it be possible.

From 10° to 5° N. there will be 8 or 9 per cent. of calms, with the winds variable from SE. to E. and NE. No matter what the direction of the wind, so long as it blows between these three principal points, vessels should haul close to the wind on the port tack, so they will make a true ESE. course, and will cross 5° N. near 45° W.

Beyond 5° N. the winds will be well established from SE., varying, however, at times to E., and the course should be continued on the port tack until the equator is reached, which will generally be somewhere near 45° 30′ or 46° W. At this point vessels should go about, and can make a good ENE. course, with the winds fresh from SE.; this should continue until 5° N. is crossed a second time, which latter crossing should be at 35° W., when, if the winds persist at SE., the same course should be still more extended. But after having crossed 5° N. a zone will be entered, containing 15 per cent. of chances of calms, and where the winds often blow from W., SW., and SE. It will, consequently, be very rarely that 6° N. will be reached without seeing the winds haul fair, *i. e.*, to SW. It will always be easy to gain 7° N. at 30° W., and the greater part of the time this meridian of 30° W. may be crossed at 6° N.

To the eastward of 30° W., there will only be 7 or 8 per cent. of calms, while the winds will almost certainly blow from S. to SW.; and ships may then make a due E. course without the least difficulty, and with no other drawback than a daily average of 4 to 7 hours of rain.

* Vessels leaving Guiana will find the winds generally at ESE., but variable from S. to NE., with 16 per cent. of calms, until the parallel of 10° N. is reached. Steam may be advantageously used in this portion of the voyage, by auxiliary steam vessels. To the northward of 10° N. the winds will be well established from NE.

The course should continue to the eastward for some time, and then gradually trend to the southward, so that 5° N. may be reached at 22° 30′ W., which may always be easily done.

From this point to the line the winds will be well established, varying from SE. to S., so that the equator may be crossed at 25° W., and the voyage terminated as was pointed out in Route Line to Bohia, p. 186, Line to Rio, p. 202, Line to Montevideo, p. 219.

In *October*, *November*, and *December:* We do not think that any other than the old route, set forth at the commencement of the present section, can be taken at this season of the year. When giving this opinion we do not by any means speak of auxiliary steam vessels, as they may always steer E. on the parallel of 7° 30′ N., overcoming the sea and winds by means of their engines, since the easterly winds are always interrupted by calms which would be favorable, but even this would be a very expensive trip, and we think it should not be undertaken except in cases of necessity.

Route from the equator to the West Indies.—Vessels leaving Cape Horn, the Cape of Good Hope, or any of the ports of Brazil, should, in order to reach the line, follow the instructions given on p. 135, p. 139, p. 186, p. 203, p. 221. After crossing the equator they should make the following points of crossing:

In *January*, *February*, and *March*, after having crossed the equator between 35° and 36° W., vessels should steer about NW. by N., as the winds will be rather well established and generally from NE., but varying at times to E. and SE., and 5° N. may be reached between 39° and 39° 30′ W. In that portion of the route comprised between 0° and 5° N., there will be only 6 per cent. of calms to be encountered; but an average of 4 to 7 hours per day of rain may be expected. After passing 5° N., the NE. trades will be met with; these being quite strong and steady will allow vessels to steer direct for their port of destination.

In *April*, *May*, and *June* the line should be crossed in the vicinity of 35° W., and the course should then be to cross 5° N. between 37° and 38° W.

From the equator to 5° N. there will be an average of 4 hours per day of rain; the chances of calms will be about 10 per cent., and the winds will vary from SE. to E. and NE.

Beyond 5° N. the course may be laid for the port of destination, since the winds will be well established from NE. The only thing to be noticed in particular is that between the meridians of 50° and 55° W., and to the southward of 10° N., there are about 25 per cent. of dead calms, and consequently that zone should be carefully avoided.

In *July*, *August*, and *September*, the equator having been crossed at 37° 30′ W., as the winds will then be well established, blowing steadily from SE., the course should be laid to cross 3° N. at 45° W., and 5° N. at 47° W.; then to reach 10° N. at 49° 30′ W. During this portion of

the route, that is, from 5° to 10° N., there will be 9 per cent. of calms, with the winds from SE. to E. and NE. After having crossed 10° N. the NE. trades will be found blowing steadily, and with them vessels may steer without the least difficulty for their port of destination.

Following the above route vessels will not, as a general thing, be retarded by calms; while between 5° and 10° N. there will be 21 per cent. of calms to the eastward of the meridian of 45° W., and 16 per cent. to the westward of the meridian of 50° W.

In *October*, *November*, and *December*, crossing the line between 37° 30′ and 38° W., vessels should steer, with well-established SE. trades, to cross 5° N. at 42° W. Beyond 5° N. there will be 6 per cent. of chances of calms, and the winds will haul from SE. to E., and will then predominate from NE.; so the course should be laid to cross 10° N. at 44° 30′ W. Between 6° and 10° N., a mean of 4 hours per day of rain may be expected. After crossing 10° N. the trades will be found well established from NE., and vessels may steer for their port of destination.

The route just given avoids the two unfavorable zones lying, the first, between 5° and 10° N. and 45° and 50° W., where there are 14 per cent. of calms; and the second, also between 5° and 10° N., but between the meridians of 35° and 40° W., where the chances of calms are 12 per cent., with an average of 6 hours' rain per day.

The remaining pages of the work of M. Labrosse have been omitted, as they particularly refer to the voyages of circumnavigation of the French national transports.

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